olume 9D, Number 4, April 1961

BULLETIN OF THE RESEARCH COUNCIL OF ISRAEL

Section D
BOTANY

Bull. Res. Counc. of Israel. D. Bot.

Continuing the activities of the
Palestine Journal of Botany,
Jerusalem and Rehovoth Series

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EFFECT OF SAND MULCH ON SPROUTING AND ESTABLISHMENT OF *TAMARIX APHYLLA* CUTTINGS AND *EUCALYPTUS GOMPHOCEPHALA* SEEDLINGS

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ABSTRACT

Cuttings of *Tamarix aphylla* (L.) Karst. and seedlings of *Eucalyptus gomphocephala* DC. were planted in the Northern Negev of Israel under annual rainfall of about 200 mm. Their early establishment was examined under various treatments of sand mulching and compared to that of cuttings and seedlings planted in undisturbed as well as dug loess soil.

While the survival percentage under the sand mulching ranged between 25 to 65, practically no survival took place in the undisturbed loess soil. Digging and additional irrigation had a somewhat favourable effect on the rooting of the cuttings and the early growth and survival of the plants.

Tamarix aphylla is one of the few trees used for afforestation in the Northern Negev of Israel where annual rainfall ranges from 100 to 200 mm. Being easily propagated without irrigation on sandy soils it is also used as a sand dune fixer. On the other hand, great difficulties are involved in its propagation on loess soil, and the cuttings generally do not root without additional irrigation. It was therefore thought worthwhile to examine whether a thin layer of sand cover applied to loess soil may improve the rooting and early establishment of the cuttings and whether such a treatment could substitute to some extent for irrigation in the first year. With

Received October 31, 1960.

these aims three experiments were carried out during the years of 1954–57 in the Northern Negev.

The first experiment was made on loess soil, 17 km south of Beersheba. On February 6th 1954 *Tamarix aphylla* cuttings 60 cm long and about 2 cm in diameter were planted in 1 sq. metre plots under the following five treatments: (1) A sand cover 10 cm thick. (2) A sand cover 15 cm thick. (3) A ditch 60 cm deep filled with sand. (4) A gravel cover 15 cm thick. (5) Control, i.e. undisturbed loess soil. The experiment was carried out in three replications and 6 cuttings were planted per plot.

On April 4th 1954 the total length of branches growing from the cuttings as well as the amount of soil moisture up to the depth of 40 cm were determined for every plot. The results are presented in Table I. It is clearly shown that in spite of the small size of the plots the cuttings grew exclusively under the sand mulch treatments and that the soil moisture content under sand or gravel mulching was considerably higher than that of the control.

In the 1956 experiment, carried out on a loess soil field 7 km west of Beersheba, six somewhat different treatments were applied in five replications each: (1) A 10 cm sand cover. (2) A 20 cm sand cover. (3) A ditch 20 cm deep filled with sand. (4) A ditch 40 cm deep filled with sand. (5) Loess soil which had been dug. (6) Undisturbed loess soil control. The plot size and number of plants per plot were as in the previous experiment.

TABLE I

Total branch length per cutting and soil moisture percentage under various mulching treatments in the 1954 *experiment*

Treatment	Total branch length per cutting (in cm)	Percentage of soil moisture	
		Depth of 20 cm	Depth of 40 cm
1. Sand cover of 10 cm	42	13.5	11.5
2. Sand cover of 20 cm	59.5	12.9	10.8
3. Ditch 40 cm deep filled with sand	99	3.9*	4.0*
4. Gravel cover of 15 cm	0	12.1	10.7
5. Control	0	9.5	7.4

* These figures represent the moisture content of the sand layer. The wilting point of loess soil was about 6–8%, that of sand 1–1.2%.

The cuttings were planted on March 7th 1956, and on May 7th 1956 the plots were examined for the number of growing cuttings and the number and length of

TABLE II

Number of sprouting cuttings and number and total length of branches per plot under various mulching treatments in the 1956 *experiment*

Treatment	Number of sprouting cuttings per plot	Number of branches per plot	Total branch length per plot (in cm)
1. Sand cover of 10 cm	5.0	29.0	1374.8
2. Sand cover of 20 cm	5.4	43.2	3163.0
3. Ditch 20 cm deep filled with sand	5.4	43.2	2656.8
4. Ditch 40 cm deep filled with sand	5.2	31.2	2152.0
5. Dug loess	3.4	18.6	680
6. Undisturbed loess	3.2	16.2	469

branches per plant. The results are presented in Table II. No further results were obtained that year because of serious damage by locusts, later in the season.

It is evident, however, that the number of the sprouting cuttings as well as that of branches per plot and the total length of branches per plot in the various treatments of sand mulch markedly exceeded that of the not covered plots. The differences between the various sand treatments were not statistically significant and those between the undisturbed control and the dug loess soil were negligible.

In the 1957 experiment carried out at the same place, the sprouting and the establishment of *Tamarix* cuttings were examined under three mulch and three irrigation (reatments. The mulch treatments were: (1) 20 cm sand cover. (2) Dug loess soil. t3) Undisturbed loess soil control. In addition to the non-irrigated control two irrigation treatments were applied. In the first an amount of 20 lt. was given to every plot on the day of planting while in the other an additional amount of 20 lt. was given on August 30th. The experiment was carried out in five replications with five cuttings only planted in every plot.

TABLE III

Per cent of survived Tamarix aphylla *cuttings under various mulchi ng and irrigation treatments in th* 1957 *experiment*

Date	No irrigation			One irrigation			Two irrigations		
	Sand mulch	Dug loess	Cont-rol	Sand mulch	Dug loess	Cont-rol	Sand mulch	Dug loess	Cont-rol
May 27	68	40	36	52	12	40	64	28	44
July 29	64	12	8	52	4	16	56	0	20
October 21	64	12	0	44	4	4	48	0	4
December 30	64	12	0	44	4	4	48	0	0

TABLE IV

Total length (in cm) of Tamarix aphylla *branches per plot under various mulching and irrigation treatments in the* 1957 *experiment*

Date	No irrigation			One irrigation			Two irrigations		
	Sand mulch	Dug loess	Control	Sand mulch	Dug loess	Control	Sand mulch	Dug loess	Control
May 27	305	62	46	178	12	79	267	24	119
July 29	470	34	11	257	14	36	384	0	31
October 21	396	31	0	249	8	5	348	0	2
December 30	418	28	0	280	8	3	340	0	0

The cuttings were planted on May 7th 1957 and the plots were examined for the number of living plants and length of branches on May 27th, July 29th, October 21st and December 30th of the same year. The results are presented in Tables III and IV. Here, too, the effect of sand cover on the sprouting and establishment of *Tamarix* cuttings is clearly shown. In the non-irrigated plots 64% of the cuttings survived the whole summer under the sand mulch while no living plant remained at the end of the summer in the control plots and only 12% remained alive in the dug loess. The fact that no statistically significant effect of irrigation was obtained in all the treatments is also instructive. However, a tendency towards somewhat favourable effect of irrigation on the control plots can be pointed out.

In 1957 a parallel experiment was set up with *Eucalyptus gomphocephala* seedlings. The number of seedlings per plot and the treatments and replications were exactly as in the *Tamarix* experiment.

TABLE V

Per cent of survived Eucalyptus gomphocephala *seedlings under various mulching and irrigation treatments in the* 1957 *experiment*

Date	No irrigation			One irrigation			Two irrigations		
	Sand mulch	Dug loess	Control	Sand mulch	Dug loess	Control	Sand mulch	Dug loess	Control
May 27	48	20	8	36	0	8	48	4	28
July 29	36	12	0	32	0	0	40	0	16
October 21	36	12	0	28	0	0	40	0	16
December 30	32	4	0	28	0	0	40	0	16

TABLE I

Total length (in cm) of Eucalyptus gomphocephala *branches per plot under various mulching and irrigation treatments in the* 1957 *experiment*

Date	No irrigation			One irrigation			Two irrigations		
	Sand mulch	Dug loess	Cont-rol	Sand mulch	Dug loess	Cont-rol	Sand mulch	Dug loess	Cont-rol
May 27	117	26	7	115	0	4	106	1	20
July 29	331	40	0	315	0	0	337	0	67
October 21	395	17	0	286	0	0	425	0	100
December 30	237	7	0	222	0	0	288	0	66

The results presented in Tables V and VI are similar to those obtained with *Tamarix*. Here, too, no seedlings survived the summer on the control plots of the non-irrigated series while 40% survived in the sand covered ones. As in the previous experiment additional irrigation had no significant effect on the survival and establishment of *Eucalyptus* seedlings. The same apparent tendency towards a favourable effect of irrigation on the control plots comes out in this experiment too.

The cited results clearly demonstrate the favourable effect of sand mulch on sprouting and establishment of *Tamarix* cuttings and on the establishment of *Eucalyptus* seedlings planted without irrigation in the loess soil of the Northern Negev where rainfall does not exceed 200 mm. Apart from possible practical implications the results are of interest from the ecological viewpoint. They are in accordance to the well known fact that in the desert even a thin sand layer improves conditions for plant growth. Sand covered areas are as a rule prominent by their denser and more vigorous vegetation.

Although the results of the 1955 experiment hint to the sand mulching improving water relations of the soil layers underneath, the 1957 experiment showed that additional water failed to markedly improve both the sprouting and establishment of *Tamarix* cuttings and *Eucalyptus* seedlings. This and the fact that even in the 1955 experiment water was available in the soil of the control and gravel treatment plots suggested that the favourable effect of sand mulch is due, apart from its effect on soil moisture, to some additional factor.

Tamarix cuttings planted in pots with loess and sand soils with ample water supply sprouted much better in the sand (Waisel 1960). This supports the assumption that sand mulching affects the sprouting of *Tamarix* cuttings and the establishment of *Eucalyptus* seedlings because of its better mechanical properties presumably bringing about better aeration.

Since no mechanically limiting factor was removed by digging of the loess in the 1957 experiment, it is probable that the sand mulch effect is due to the fact that it prevents the formation of a compact crust. Such a crust is formed as a rule on the loess soil after rain or irrigation (Hillel 1957) and might constitute a limiting factor in soil aeration. The fact that digging had a more favourable effect on the non-irrigated than on irrigated plots supports this assumption.

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CAMUSIA, A NEW GENUS OF GRASSES FROM MADAGASCAR

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ABSTRACT

Camusia, a new genus of grasses of the Eragrosteae, is described. The only species, *C. perrieri*, was originally named *Dactyloctenium perrieri*.

When the species of *Dactyloctenium* were examined, preparatory to a monograph of that genus, it was noted that *D. perrieri* Camus differed from all others in important characters. A study of all related genera indicated that a new genus was required to accommodate *D. perrieri*, which I propose to call *Camusia*, in honour of Mlle. A. Camus, the eminent student of Mascarene grasses.

Camusia Lorch gen. nov.
(Figures 1 - 7)

Spiculae oblongae, lateraliter valde compressae, monoseriatae vel biseriatae, ad rhachidem planam continuam subsessiles; rachilla non disarticulans. Anthoecia 4–10, summo reducto excepto omnia gynandria; glumae patentes, uninerviae, carinatae, acuminatae, glabrae, marginibus membranaceis exceptis rigidae; gluma inferior superiore brevior; lemmata imbricata, carinata, complicata, a latere visa rhomboidea, acuta vel acute acuminata, apice mucronata vel breviter aristata, integra, 3-nervia, nervis viridibus lateralibus infra partem lemmatis apicalem desinentibus, lemmata matura caduca; paleae lemmatibus subbreviores, complicatae, bicarinatae, acutae, persistentes; lodiculae duae, minutae, truncatae; stamina tria; antherae oblongae; styli longiusculi, basi connati. Fructus a latere visus subtrigonus vel ellipsoideus, lateraliter compressus; pericarpium tenuissimum siccitate adhaerens; scutellum circiter tertiam partem seminis aequans; hilum basale, punctiforme.

Gramen annuum, a basi ramosum; culmi gracillimi; ligulae brevissime hirsuto-marginatae; lamina linearis vel anguste lanceolata, involuta; spicae paucae e nodis 2–5 orientes.

Species unica, Madagascarem incola.

Camusia perrieri (Camus) Lorch comb. nov.

Dactyloctenium perrieri Camus in Bull. Soc. bot. Fr. 75, 913 (1928).

Received May 8, 1960.

Figure 1

Camusia perrieri (Camus) Lorch comb. nov. Type (Madagascar, Majunga; Perrier de la Bathie 17975). Natural size.

Figure 2
Spikelet with section of rachis.
Two lemmas have abscised.

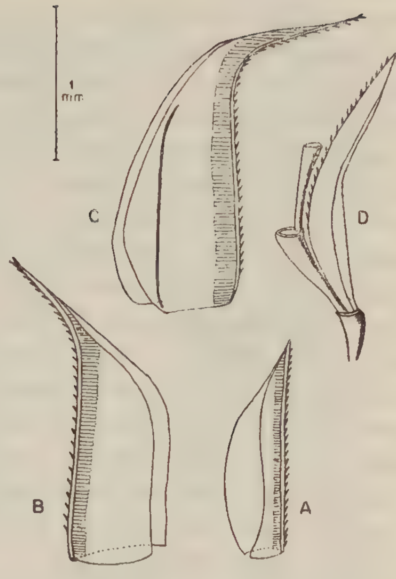

Figure 3
Glume, palea, lemma. A – lower glume;
B – upper glume; C – lemma; D – palea
with part of rachilla.

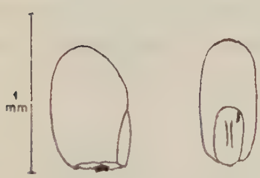

Figure 4
Seed; profile and dorsal
view.

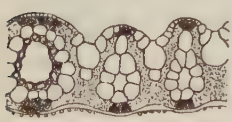

Figure 5
Cross-section of leaf, schematised, showing a primary and two secondary veins. Hatched-sclerenchyma; stippled-thin-walled photosynthetic parenchyma with cells arranged radially around veins. Bundles omitted. (×20).

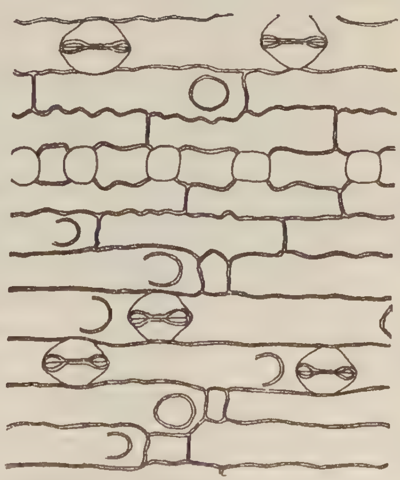

Figure 6
Lower epidermis showing silica cells and papillae. (×900).

Annual; culms geniculate – ascending, delicate, smooth, 10–40 cm long. *Leaves* 3–10 cm long, with sheaths one fifth to one half of this; lowermost leaves aggregated, with persistent coriaceous sheaths. Sheath striate, glabrous; ligule a short fringe of hairs. Blade lanceolate, involute, with scattered silky hairs on lower side. *Inflorescence* a raceme of 2–6 erect or divergent spikes, 1.5–6 cm long, at two or more levels, in partly digitate arrangement or irregular, with some spikelets sessile on the culm; glabrous pulvinus at juncture of rachis and culm. Rachis 1 mm wide, flattened, glabrous, gradually tapering to a blunt tip, not projecting beyond the tip of the terminal spikelet. *Spikelet* 4–12–flowered, laterally compressed, 3–6 mm long. The two rows of spikelets are closely approached. They are adpressed to the rachis with their tips pointing distally. Florets spaced 1 mm apart; all but the terminal are fertile. *Glumes* rigid, acuminate, 1-nerved; the lower 1.5 mm, the upper 2 mm long, with short recurved tip. *Lemmas* 2–2.5 mm long, oblong in profile, deciduous. Median nerve, accompanied by two strips of green tissue, tapers to a short recurved awn, lateral nerves green, parallel to median nerve, ending blindly. *Palea* acute, with two hispid nerves, almost as long as lemma, persistent. *Anthers* 3, 1 mm long. *Styles* two, plumose in upper half. *Pericarp* membraneous, free. *Seed* 0.5–0.7 mm long, translucent, in profile roughly elliptical, more or less laterally compressed; dorsal face rounded or flat, not grooved; *surface of seed* faintly striate or tubercled, or smooth; *embryo* one third as long as seed; hilum in the centre of a circular concavity.

Type: Madagascar, dune north of Majunga, 5. 1927 *Perrier de la Bathie* 17975, K. Also collected at Ankarafantsika, *P. de la Bathie* 99, K, and at dune near Majunga, 4. 1922 *P. de la Bathie* 14665, K.

Camusia is a member of the Eragrosteae, as interpreted by Hubbard (Hutchinson: Families of Flowering Plants vol. ii). It most closely resembles *Acrachne* and *Dactyloctenium*. The following is a brief comparison between these genera (Table I).

TABLE I

	Camusia	*Acrachne*	*Dactyloctenium*
Inflorescence	Two or more-storied or irregular	Several-storied	Digitate
Rachis of spikes	Flattened	Flattened	Triquetrous
Spikelets	Widely spaced, apparently in one row, pressed against rachis	Widely spaced, apparently in one row, pressed against rachis	Densely arranged, strictly in two rows perpendicular to rachis
Lemma	Deciduous, lateral nerves weak, ending blindly	Deciduous, lateral nerves produced to short tips	Persistent as a rule, at least in upper florets; lateral nerves end blindly
Seed	Smooth or very faintly sculptured; no dorsal groove	Ridged, deep dorsal groove	Ridged or tubercled, dorsally rounded, or with very shallow groove

Figure 7

Camusia perrieri (Camus) Lorch comb. nov.
By kind permission of the Director, Royal Botanic Gardens, Kew.

The inflorescence of *Acrachne verticillata* (a monotypic genus) typically comprises several sets of 2–3 long spikes, yet a few collections consist of plants with irregular inflorescences, of two or more spikes at several levels, with some spikelets sessile on the main axis (e.g. Punjab, 12. 1846, *Thomson*, K).

Camusia perrieri is not available in sufficient numbers for an exhaustive study of its inflorescence, yet it appears to be highly variable. Available plants either bear three spikes, 4 cm long, at two levels, or several short spikes at a few levels, with odd spikelets sessile on the main axis. The spikelets of *Camusia* are borne on a much flattened rachis, in what is virtually a single row, 8 spikelets per 10 mm of rachis, as against 20 in *Dactyloctenium*. The spikelets are adpressed to the rachis.

In *Acrachne* and *Camusia* the spikelets are almost in a single row, and the lemmas are readily deciduous, clasping the seeds. Yet *Camusia* lacks the key character of *Acrachne* — two short points which terminate the lateral nerves of the lemma on both sides of the median mucro. In *Camusia* the lateral nerves end blindly. Another important difference between *Acrachne* and *Camusia* concerns the seed. In *Acrachne* the surface of the seed is heavily ridged and the seed has a deep dorsal groove, which a survey of the Eragrosteae has shown to be very rare in this tribe. *Camusia*, on the other hand, has smooth or very faintly sculptured, dorsally rounded seeds. It is because of its unique combination of inflorescence, spikelet and seed characters that it seems necessary to erect a new genus for *C. perrieri*.

Leaf anatomy and structure of epidermis generally agree with *Acrachne*, *Dactyloctenium*, *Arthrochloa*, as well as with some species of *Eragrostis*. The cross-section shows main veins with double sheaths, alternating with 3–6 secondary veins, with inner sheath much reduced or lacking. Photosynthetic tissue is arranged radially round the outer, large-celled sheath, which also contains chloroplasts. The lower epidermis, where it is overlying the bundles, consists of one or several alternate cell rows with silica bodies which comprise alternating silica cells and short cells. Cork cells are missing. The silica cells, seen from above, are circular or slightly elliptical or elliptical-truncate, looking like a barrel when seen in profile. The epidermal cells which do not overlie bundles show more or less highly developed papillae (Figures 5, 6).

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ON THE OAK SPECIES OF THE MIDDLE EAST

M. Zohary

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ABSTRACT

The present paper is a contribution to the knowledge of the Middle Eastern oaks. 18 species, 35 varieties and forms are dealt with. New localities are recorded and the vegetational significance of the species as well as their taxonomical relations are discussed. Particular attention is given to the section *Aegilops* which since Kotschy (1862) has not been critically reexamined.

The middle East, and particularly its northern part, is one of the centres of the genus *Quercus* in Eurasia. Turkey, for instance, harbours over 30 species (spread over 9 sections), Syria and Lebanon — 8 species, Iraq — 5, and Palestine — 3.

While one constituent of this oak flora could be considered as an ancient relic, another is probably a fugitive assemblage of species which were driven hither from northern Eurasia by the advance of the cold in Late Tertiary and during the Glacials. It was probably this oak group which has supplied the few species of *Quercus* that have reinhabited the Eurosiberian region in the Interglacial and the Postglacial periods.

The extraordinary pheno - and genotypical plasticity of many species and the abundance of intergrading forms and hybrid swarms between species support the assumption that the area under review presents one of the few centres of speciation of the genus *Quercus*. This is further evidenced by the occurrence of a comparatively high number of endemic, stenotop species, such as *Q. cedrorum*, *Q. kotschyana*, *Q. longifolia*, *Q. vulcanica*, *Q. bornmuelleriana*, etc.

A series of species are mutually almost exclusive in their distribution. Examples are: *Q. brantii*, *Q. macrolepis* and *Q. ithaburensis* which divide among themselves the local area of the section *Aegilops*, or the pairs *Q. dshorochensis* — *Q. polycarpa*, *Q. infectoria* — *Q. boissieri*, etc. An interesting point in the distribution of oaks in the region is the close approach of some of them — e.g. *Q. pubescens* ssp. *anatolica*, *Q. brantii*, *Q. cerris*, *Q, calliprinos* — to the borders of the local steppes and deserts.

Since the beginning of the last century, the oaks of the area under review have been studied by various authors, among them Koch (1849), Kotschy (1862), Schwarz (1934, 1936b, 1936–37) and Camus (1934–39). At present there is a disagreement among the students of this genus as to the evaluation and delimination of many taxa. For instance, many binomials established by Kotschy were reduced in rank or synony-

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mized with other taxa by Boissier (1879), while their specific rank was maintained by De Candolle (1864), Tchihatcheff (1866) and Wenzig (1887), and again reduced by Schwarz (l.c.) and Camus (l.c.).

This divergence of opinion no doubt stems from differences in interpretation of the tremendous variation in leaf and fruit characters that have brought about incertitude in oak identification even among botanists and foresters. So, for instance, Walter (1956) in his vegetation analysis of Anatolia avoids dealing with oaks and oak forests (except for *Q. macrolepis*) by saying: "Sie (the oaks) sind für die Floristen das schwierigste Kapitel in Anatolien". Another example is the forest map issued by the Forest Department of the Turkish Government in which all the oak forests (again with the exception of the vallonea — *Q. macrolepis* — forests) are dealt with as a single unit.

At the present stage of knowledge, I felt that additional information concerning taxonomy, distribution, ecology and vegetational relations of the local oak species may be of help both to students of the vegetation and to the foresters interested in this genus*.

The data communicated here are based on field observations and on the study of vast collections of herbarium specimens at the Herbarium of the Hebrew University of Jerusalem and also of Herbier Boissier, Genève, Herbaria of the Royal Botanic Gardens, Kew and Edinburgh, Herbarium of the Muséum National d'Histoire Naturelle, Paris, and the Herbarium of the Ankara University.

In the sectional subdivision and sequence I followed Schwarz's monograph (1936–37), which I consider the most critical treatment of this genus in the Middle East.

Not all the specimens examined are cited here; some details in citation have also been omitted for the sake of brevity. In a few cases specimens without number and collector's name are cited. All the specimens mentioned are deposited in the Herbarium of the Hebrew University, Jerusalem, except if otherwise stated. In the spelling of localities the original transcription of the herbarium labels has mostly been followed.

For easier orientation the various regions of the countries concerned are referred to as N (north), W (west), C (central), S (south), E (east). For Palestine the following abbreviations of district names are used: A = Ammon, CA = Carmel, DV = Dan Valley, E = Edom, EP = Esdraelon Plain, G = Gilead, J = Judaean Mountains, LG = Lower Galilee, S = Sharon Plain, SA = Samaria, UG = Upper Galilee. The names of collectors, except those mentioned once, are abbreviated as follows: *A* = I. Amdurskv, *At* = N. Atakan, *B* = H. Birand,! *C* = E. Can, *Ce* = R. Çetik, *D* = P. H. Davis, *De* = P. Delbes, *Du* = S. Duvdevani, *E* = A. Eig, *Ev* = M. Evenari (W. Schwarz), *F* = N. Feinbrun, *G* = E. Guest, *Gr* = A. Grizi, *H* = I. C. Hedge, *I* = S. Inal, *K* = K. Karamanoglu, *Ka* = I. Karschon, *Kp* = B. Kasapligil, *Ko* = A. Konukçu, *Ky* = T. Kotschy, L = M. Litwak, *N* = McNeill, *O* = G. Orshan, *P* = N. Polunin, *Po* = G. E. Post, *S* = Shiron, *W* = H. Walter, *ZD* = D. Zohary, *ZM* = M. Zohary.

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* The species of the section *Roburoides* will be dealt with in another paper.

Sect. **Robur** Rchb.

Quercus hartwissiana Stev. in Bull. Soc. Nat. Mosc. 30,1: 387. 1857.
Schwarz, Monogr.: 93, Atlas: t. 15. 1936–37; A. Camus, Monogr. 2: 195. 1938–39.

TURKEY. N: Prov. Istanbul, Çatalca, Dorf Alaton, about 200 m, *C* 134; 10 km E. of Samsun, nesophilous forest, *ZM* et *ZD* 2247; prov. Ordu, Fatsa, about 900–1000 m, 632; im Wald bei Artwin, *K* 85. W: Ascent to Uludag above Bursa, forest of *Pinus nigra*, *ZM* et *ZD* 2372. C: Prov. Yozgat, Akdagmadeni, about 1650 m, *At* 613. E: Başkale-Hakkari (Çölemerik), about 50 km from Başkale, 800 m, *N* 702.

Around Bafra this species is dominant in the *Quercus—Carpinus* forest covering arge streches on the slopes facing the Black Sea. It is associated here with *Crataegus nonogyna*, *Cotinus coggygria*, *Mespilus germanica*, *Rhododendron ponticum* and others. In the coastal plain near Samsun we have noted this species also in a somewhat wampy forest, dominated by *Fraxinus excelsior* and *Alnus barbata*.

Quercus pedunculiflora C. Koch in Linnaea 22: 324. 1849
Schwarz, Monogr.: 111, Atlas: t. 20. 1936–37; A. Camus. Monogr. 2: 372. 1938–39.

TURKEY. N: Prov. Istanbul, Çatalca, S. von Sinekli, ord. Kabaklik, *C* 138; betw. Bolu and Abant, *ZM* et *ZD* 3546. W: 300 m above Bursa, forest and clearings, *ZM* et *ZD* 2037. C: About km N. of Ankara, 1200–1400 m, *ZM* et *ZD* 2287. E: Prov. Hakkari, 180 km nach Van, Fluss Zab n *Fraxinus* Wald, about 1800 m, *K* 120.

This species has a wide ecological range. An associate of the rather mesophytic orest of northwestern Turkey (e.g. Bolu-Abant), it also forms thin stands and someimes a shrubbery on the border of the Central-Anatolian steppe. In the Ankara rea solitary specimens of this oak scattered here and there may testify to the former xistence of oak forests in this timberless area. Similar remnants of former destroyed orests are the trees and shrubs, which have been left as "fruit trees", e.g. *Pyrus laeagrifolia*, *Crataegus orientalis*, *Prunus spinosa*, *Celtis tournefortii*, *Amygdalus ommunis*. These wild "fruit trees" abound in cultivated fields, vineyards and in therwise protected plots, and are very characteristic of the border between woodand and steppe.

Sect. **Dascia** Ky.

Quercus macranthera F. et M. ex Hohen. in Bull. Soc. Nat. Mosc. 11: 259. 1838
Schwarz, Monogr.: 122, Atlas: t. 24. 1936–37; A. Camus, Monogr. 1: 622. 1936–38.

IRAQ. N: Seri Hassan Beg, on the mountain side, 2000 m, *G* 2898. IRAN. N: N. slopes of Elburz Mts., facing the Caspian Sea n. Chalus, *ZM* et *ZD* 644.

This species which characterizes the higher altitudes of the Caspian mountains vas found by Gauba (1954–55) and others as the dominant tree associated with *Carpinus betulus*, *Acer opulifolium* and others. It reaches the timber line (2300–2400 m) n the surroundings of Chalus.

Quercus frainetto Ten. Fl. nap. I, Prodr. Suppl. 2: 72. 1811
Schwarz, Monogr.: 132, Atlas: t. 29. 1936–37; A. Camus, Monogr. 1: 627. 1936–38.

TURKEY. N: Prov. Edirne, Uzunköprü, *R. Bilci* 575; prov. Istanbul, Belgrad Forest, *ZM* et *ZD* 3107; E. of Izmit, 20 m, in stands with *Q. cerris*, *D* et *H* 32910; prov. Bolu, Düzce-Hendek, 00 m, mixed oak wood on S. slope, *D* et *H* D/32903; zwischen Samsun und Ankara, 37 km nach

Samsun entlang der Strasse, *K* 89; about 20 km S. of Tokat, *Quercus cerris — Carpinus* forest, *ZM* et *ZD* 38493. w: Prov. Balikesir, Edremit Berg "Kaz dagi" (Ida), *K* 100; about 30 km SW. of Balikesir on the way to Izmir, *ZM* et *ZD* 2556.

Q. frainetto is one of the most common oaks in northern Turkey. It is lacking altogether in typical Mediterranean and Irano-Turanian areas, preferring rather Euxinian conditions In the environs of Tokat it is scattered in the somewhat xeric *Q. cerris—Carpinus orientalis* forest which is characteristic of this area. Other associates of this forest are *Q. infectoria, Celtis tournefortii, Pistacia palaestina*, etc. In the Düzce valley it is the dominant tree of the mesophytic forest and is associated with *Acer campestre, Fraxinus excelsior, Pyrus syriaca, Cornus mas, Crataegus monogyna*, etc. In the environs of Balikesir we noted this species as codominant with *Q. infectoria*, *Pyrus syriaca, Juniperus oxycedrus, Paliurus australis, Prunus* spp.

Quercus pubescens Willd. ssp. **anatolica** Schwz. in Rep. 33: 336. 1934
Monogr.: 170, Atlas: t. 39. 1936–37.

Q. pubescens Willd. ssp. **anatolica** Schwz. f. **crispata** (Stev.) Schwz. Monogr.: 173. 1936–37.

Q. lanuginosa Lam. ssp. *crispata* (Stev.) A. Camus, Monogr. Atlas 2, Expl.: 42. 1935–36.

TURKEY. w: Prov. Balikesir, Dursunbey, Turna dere, about 850 m, 713; prov. Bursa, Berg Uludag, *Quercus* zone, *K* 98; prov. Manisa, Muradiye, Wald Karaali, about 65 m, *B. Ünsal* 629; prov. Kütahya, Sabuncupinar, *E. Özen* 606. c: Prov. Ankara, Çankiri, Sarikaya, about 1300 m, *V. Yüksel* 622. s: Auf Bergen SW. von Akşehir, *K* 74.

Q. pubescens Willd. ssp. **anatolica** Schwz. f. **variabilis** Schwz. Monogr.: 173. 1936–37.

TURKEY. N: Betw. Kirklareli and Çorlu, *B* 80; betw. Bolu and Abant, forest and forest margin, *ZM* et *ZD* 3551; betw. Kastamonu and Çankiri, n. the village Inkö, *Q. cerris* forest, *ZM* et *ZD* 2105; about 15 km SE. of Sinop, *Q. calliprinos — Carpinus orientalis* stand, *ZM* et *ZD* 3162; 70 km S. of Sinop, *Quercetum pubescentis*, *ZM* et *ZD* 3455; about 20 km S. of Amasya, valley of Yeşil Irmak River, among forest remnants, *ZM* et *ZD* 2006; about 20 km S. of Tokat, *Quercus — Carpinus* forest, *ZM* et *ZD* 3144; 13 km S. of Çamlibel, betw. Tokat and Sivas, *Quercetum*, *ZM* et *ZD* 3153. w: 4 km W. of Balikesir, forest remnants, *ZM* et *ZD* 3313; 300 m above Bursa, forest and clearings of *Quercus*, *ZM* et *ZD* 2042. c: Prov. Ankara, Hacikadun deresi, 680. s: Prov. Mugla, Baba dag near Fethiye at Ovacik, *D* 13712; prov. Isparta, S. Karaagaç 621. E: 13 km S. of Hasançelebi, betw. Sivas and Malatya, 1000 m, *ZM* et *ZD* 2655.

In the treatment of forms of *Q. pubescens* I am following Schwarz in including all the Anatolian material of *pubescens* within the ssp. *anatolica*. Nevertheless, it is quite clear that in Anatolia this highly variable species may also comprise forms of *Q. pubescens* ssp. *lanuginosa* var. *undulata*, as well as of *Q. brachyphylla* which is recorded only from the Izmir province.

The taxonomy and phytogeography of *Q. pubescens* in Turkey deserve a more intensive study. Although the species is very variable also outside Anatolia, it seems that a better knowledge of its variability in Turkey may cast some light on its migration history. Schwarz (1936–37) is completely right in assuming that some forms of this subspecies may represent hybrids between *Q. pubescens* ssp. *anatolica* f. *crispata* and *Q. infectoria*. Indeed, we found intermediate forms which cannot be included in either of the respective taxa.

The subspecies *anatolica* is widely distributed in Turkey, notably in the Euxinian and Sub-Euxinian belts. It also occurs on solitary slopes facing the Anatolian steppe

It is frequently shrubby as a result of browsing and cutting. It seems to be differentiated into a series of ecotypes.

Forests with *Q. pubescens* as a dominant have also been observed between Çankiri and Kastamonu. In the neighbourhood of Ilgaz this species is associated with *Q. infectoria*. In the Euxinian mountains between Sinop and Görze, on the slopes facing north and northwest, forests of *Q. pubescens* and *Carpinus orientalis* including *Q. frainetto* are characteristic of the landscape. Along with these trees one finds *Cornus mas*, *Crataegus monogyna*, *Rhododendron ponticum*, *Juniperus excelsa*, *Prunus* spp., *Paliurus australis*, *Clematis vitalba*, *Ruscus aculeatus*, *Phillyrea media*. *Q. pubescens* also occurs as a shrub, sometimes even less than 1 m high, forming the underwood of *Pinetum nigrae* or *Pinetum brutiae*.

Sect. **Gallifera** Spach

Quercus boissieri Reut. ex Boiss. Diagn. Ser. 1, 12: 119. 1853
Schwarz, Monogr.: 185. 1936–37.

Q. infectoria Oliv. ssp. *boissieri* (Reut.) Gürke, Pl.eur. 2: 69. 1897; A. Camus, Monogr. 2: 187. 1938–39.

Q. boissieri Reut. var. **petiolaris** (Boiss.) Zoh. comb. nov.

Q. boissieri Reut. ssp. *petiolaris* (Boiss.) Schwz. Notizbl. 13 (116): 17. 1936 et Monogr.: 190, Atlas: t. 46. 1936–37.

Q. infectoria Oliv. ssp. *boissieri* (Reut.) Gürke var. *petiolaris* (Boiss.) A. Camus, Monogr. 2: 187. 1938–39.

TURKEY. S: Maraş-Göksun n. Yemiş dag, 600 m, open *Pinus brutia* forest, *D* et *H* 27514; Amanus Mts., n. Jebel Musa, betw. Col de Celdrin and Bithias, 600–700 m, *E* et *ZM* 1382; village of Karagouz, 500 m, vineyard, *E* et *ZM* 1116; ouest d'el Ourdou, gabbros de serpentines, 500 m, *De* 1231. IRAQ. N: Distr. Dohuk, betw. Suwara Tuka and Barash, forest of *Q. boissieri*, *E* 1155; Bursorini gorge n. Ruvendiz, about 1000 m, *G* 464; distr. Sulaimaniya, Qara Dagh, Kanitacht, 1440 m, *Quercetum brantii*, *E*, *F*, et *ZM* 1117. SYRIA. S: Antilebanon, forest of *Q. boissieri* 1368, 1369, 1370.

Q. boissieri Reut. var. **microphylla** (A. Camus) Zoh. comb. nov.

Q. infectoria Oliv. ssp. *boissieri* (Reut.) Gürke var. *microphylla* A. Camus, Monogr. 2: 188. 1938–39.

TURKEY. S: Amanus Mts., betw. Achagi Zarkoun and Bakajak, about 1800 m, 1270; Kizil Dagh, S. de Souklouk, 800 m, *De* 1280; Ak-Tepe, 80 km N. of Antiochia, 700 m, basalt, *De* 1276; Beylan, gabbros de serpentines, 500–600 m, *De* 1273.

Q. boissieri Reut. var. **stenophylla** (Eig) Zoh. comb. nov.

Q. infectoria Oliv. ssp. *boissieri* (Reut.) Gürke var. *stenophylla* Eig ex A. Camus, Monogr. 2: 188. 1938–39.

TURKEY. S: Amanus Mts., n. Jebel Musa, env. of Ikiskabry, 400 m, *E* et *ZM* 858.

Q. boissieri Reut. var. **latifolia** (Boiss.) Zoh. comb. nov.

Q. boissieri Reut. ssp. *latifolia* (Boiss.) Schwz. in Notizbl. 13 (116): 17. 1936 et Monogr.: 187, Atlas: t. 44. 1936–37.

Q. infectoria Oliv. ssp. *boissieri* (Reut.) Gürke var. *latifolia* (Boiss.) A. Camus, Monogr. 2: 189. 1938–39.

TURKEY. N: About 20 km S. of Kastamonu, *ZM* et *ZD* 2586; about 40 km S. of Amasya, valley of Yeşil Irmak, among forest remnants, *ZM* et *ZD* 2006. W: About 30 km SW. of Balikesir on the

way to Izmir, *ZM* et *ZD* 2555. S: Prov. Mugla, distr. Fethiye, Dorf Zoulah, 699; prov. Konya, Sultandag n. Ladik, *B*, *ZM* et *ZD* 2160; prov. Antalya, 17 km S. of Serik, *Quercus—Pistacia atlantica* forest, *ZM* et *ZD* 3078; Taurus Mts., betw. Antalya and Beyşehir, 18 km N. of Ak-Siki, *ZM* et *ZD* 3444; env. of Jemele, betw. Mersin and Fundukpinar, 500 m, *Pinetum brutiae* partly destroyed, *E* et *ZM* 1294; 20 km N. of Pazarçik, betw. Maraş and Malatya, 800–900 m, *ZM* et *ZD* 3018; Iskenderun-Sogukoluk, about 700 m, 10 km of Içerde, *Kp* 10; Amanus Mts., Jebel Musa, betw. Col de Celdrin and Bithias, 600–700 m, *E* et *ZM* 1259; valley on the southern ranges of the Cassius Mts., betw. Latakia and Antiochia, 100 m, *E* et *ZM* 339. E: 13 km S. of Hasançelebi, betw. Sivas and Malatya, W. side of hill, 1000 m, *ZM* et *ZD* 2655; 26 km S. of Malatya, *ZM* et *ZD* 3302; 32 km nach Elazig am Rand des Hazar Sees, *B* et *K* 113; prov. Urfa, N. slope of Karacadag, betw. Siverek and Diyarbakir, 1250 m, rocky basalt gulley, *D* et *H* 28297; prov. Bingöl, n. Solhan, *D* et *P* 24792. IRAQ. N: 16 km N. of Zakho, n. the village Bursiki, 505 m, *ZM* et *Du* 398; distr. Dohuk, Zawitah, steep slope 1050 m, *G* 1249; distr. Erbil, betw. Mazna and Handian, 520 m, *Quercetum brantii*, *E* et *ZM* 1258; Ruvendiz gorge, n. Alana Su, 680 m, *E* et *ZM* 1243; distr. Penjwin, Ahmed Kulvan, 1230 m, *E et ZM* 1166; Jebel Sebaran, n. Tankabiya River, *E* et *F* 1226; distr. Sulaimaniya, ascent to Pir-i-Mukurun Dagh, 1100–1200 m, *E* et *Du* 1175; Qara Dagh, Kanitacht, 1440 m, *Quercetum brantii*, *E*, *F* et *ZM* 1144. CYPRUS. Troodos, Kakopetrie, *Ev* 1221; Sina Oros, *Ev* 1251. SYRIA. S: Faradis, foot of Mt. Hermon, about 450 m, *E* 1287; Antilebanon, Wadi Quaren, env. of Djdeide, betw. Beirut and Damascus, *E* et *ZM* 1361; 74 km SW. of Damascus, 950 m, *E* et *ZM* 1306. LEBANON. N: Betw. Sir and Ptermese, 750–900 m, E of Tripoli, *Stud. Rer. nat.* 1253; Jebel Qammuha, E. of Fnediq, *Abietum cilicicae*, *Bot. Dept.* 1311. S: Ain Zahlta, *Pinus pinea* forest, *F* 1334. PALESTINE. UG: betw. Hurfesh and Peqi'in, *E* 1245. CA: Betw. Isfia and Daliat-el-Carmel, *E*, *F* et *ZM* 1130. SA: Env. of Jafne, *F* 1296. J: Qubeiba, n. Nabi Samuel, *Ev* 1110.

Quercus infectoria Oliv. Voy. Emp. oth. 1: 252, tt.: 14,15. 1801

Schwarz, Monogr.: 195, Atlas: tt. 48–49. 1936–37; A. Camus, Monogr. 2: 183. 1938–39.

TURKEY. N: About 20 km S. of Kastamonu, *Quercus—Carpinus* forest, *ZM* et *ZD* 2596; betw. Sinop and Samsun, slope facing the Black Sea, *ZM* et *ZD* 3152; plateau of Çamlibel dagi betw. Tokat and Sivas, *Pinus sylvestris* forest, 1500–1700 m, *ZM* et *ZD* 2020; prov. Çoruh (Artvin), Borçka-Artvin in Çoruh gorge, 350 m, *D* et *H* 32423. W: Prov. Balikesir, distr. Bandirma, Yeniceköy, about 200 m, 714; Edremit Berg, Kaz dag (Ida), about 1200 m, 637; nach Denizli im *Pinus brutia* Wald, *K* 108. C: 40 km NW. of Ankara, *Quercetum infectoriae*, *ZM* et *ZD* 2356. S: Ouest d'el Ourdou, 500 m, *De* 1263. E: Prov. Elazig, Hazar Gölü, about 1135 m, n. mouth of stream, *N* 477.

Only part of the large number of specimens of the above two species from the region under review are cited here.

While there is justification in keeping *Q. boissieri* apart from *Q. infectoria* — and this is supported also by the almost exclusive geographical areas of these two taxa — there is scarcely any morphological-geographical basis for dividing *Q. boissieri* into subspecies. The varieties recorded above occur in the same populations and also intergrade. In my opinion it is also impossible to subdivide *Q. infectoria* into sspp. *puberula* and *glabra*.

Q. infectoria is limited in Turkey to the Euxinian and Sub-Euxinian sector of the Eurosiberian territory and scarcely forms any conspicuous stands there. *Q. boissieri*, on the other hand, extends from the Armeno-Kurdistanian mountains to the Zagros and the Antitaurus, and from the Aegaean and Mediterranean Anatolia through Amanus and Cassius, Lebanon and Antilebanon mountains to the mountains of western Palestine. It is an East Mediterrano — Irano-Turanian orophyte which avoids Eurosiberian conditions. Its distribution in the Middle East coincides to a great extent with that of *Q. libani* but exceeds the latter in area. *Q. boissieri* forms considerable pure or mixed stands in the montane zone. It also descends to lower altitudes, wherever more humid conditions prevail. In Iraqian Kurdistan, for instance, in the Amadia area (alt. about 1100–1200 m) there are considerable stretches

of forest in which the dominant *Q. boissieri* is associated with *Q. brantii*, *Pistacia khinjuk*, *Paliurus australis*, *Amygdalus communis*, *Pyrus syriaca*, *Crataegus monogyna*, *Juniperus oxycedrus*, etc. On the western slopes of the Zagros Mts. in Iraq, this type of forest also occurs without *Q. brantii*. In the Dohuk area *Q. boissieri* may under more favourable conditions be associated with *Q. libani* which is also very common there.

In the mountains of Amanus there are large almost pure stands of this species which mainly occupy the higher zone (e.g. in the surroundings of Karakisie). *Q. boissieri* stands are also found in the lower zone with evergreen maquis shrubs as underwood. Sometimes *Q. boissieri* occurs as an underwood shrub in the *Pinus brutia* forest. In higher altitudes (e.g. 1300–1850 m) of the Amanus Mts., one occasionally encounters *Q. boissieri* together with *Q.* cerris, both as underwood shrubs in the *Pinetum nigrae*. Further south, on Mt. Cassius and in the Lebanon and Antilebanon, *Q. boissieri* is a fairly common forest tree forming pure stands or mixed with maquis elements. In Palestine, due to the more arid climate and to the lack of higher altitudes, only fragments of this forest type occur in the Mediterranean mountain zone.

Sect. **Suber** Rchb. em. Schwz.

Quercus alnifolia Poech, Enum. Pl. Ins. Cypr.: 12. 1842

Schwarz, Monogr. Atlas: t. 54. 1936–37; A. Camus, Monogr. 1: 430. 1936–38.

CYPRUS. Above Kakopetrie in pine forest, 2800 ft, *L.F.H. Merton* 2811; Mt. Troodos, n. Platania, *Ev* 338; Platres, 1300 m, *Pinetum brutiae*, *F* 388.

This species is rather isolated taxonomically and has no close relative either in the Middle East or in southern Europe.

Sect. **Aegilops** Rchb. em. Schwz.

This section is well delimited from all other sections of the genus by a series of characteristics. It is mainly a Near-East group of several deciduous species which display great morphological plasticity. It includes among others the well known "vallonea" oaks in which the cupules of the acorns are commercially exploited for tanning. Kotschy (1862) who classed this group as *Pachyphlonis* included therein the following binomials: *Q. macrolepis* Ky., *Q. graeca* Ky., *Q. vallonea* Ky., *Q. ithaburensis* Dcne., *Q. ungeri* Ky., *Q. ehrenbergii* Ky., *Q. pyrami* Ky., *Q. brantii* Lindl., *Q. persica* Jaub. et Sp., *Q. oophora* Ky.

The binomial *Q. aegilops* L., which has long figured as the name of one of the main, but never well defined species of this group, has been discarded and abandoned by Kotschy (1862), De Candolle (1864), Wenzig (1887), Schwarz (1936b, 1936–37) and others, because its description does not fit any species of this section. Camus (1936–38), Boissier (1879) and others, nevertheless, retained it as a collective binomial comprising several subspecies or varieties of this group.

Since Kotschy (l.c.) nobody has revised this group critically. The tremendous variability of certain taxa, the extreme rarity of some others, and the lack of field

observations in most of the taxa brought about misidentification in herbaria. Inal (1959) has divided the Turkish "vallonea" oaks into 10 types each comprising several minor forms. Boissier (l.c.) reduced several species to varieties. Camus (l.c.) raised some of these varieties to subspecies, while retaining specific rank for others. Schwarz (1934, 1936–37) retained some at specific or subspecific rank and discarded some others.

The following presentation of taxa of this section is based on the examination of a large number of specimens, both in field and in the herbarium.

Quercus ithaburensis Dcne.

This species has been described from a specimen collected by Bové from Mt. Tabor, bearing young acorns. Later Kotschy collected this species in the same locality and also on Mt. Carmel. It is a well delimited species and comprises also the binomials *Q. pyrami* Ky., *Q. ungeri* Ky. p.p. and also *Q. goedelii* Ky. (It.cilic. No. 387).

Q. ithaburensis possesses an extraordinarily wide range of variability especially in the fruit characters, surpassing all other species of the reviewed area. The acorn varies in size from 1 to 5 cm in length and from 0.8 to 3 cm in width; the shape of the gland varies from cylindrical to lanceolate, ovate and elliptical, and from obtuse to acute and acuminate. The cupule is turbinate to round-ovate at the base; the upper and middle cupular scales vary from short-ovate to long-linear and filiform; from appressed and partly adnate to recurved, deflexed, spreading or erect and free.

Contrary to Schwarz's statement (1934) each individual tree is strictly uniform in its fruits, but in each stand a variety of fruit forms may occur, though one particular form often takes dominance over others. Of the bewildering array of varietal combinations, the author has picked out only a few which are based on qualitative, discontinuous characteristics. The basic pattern of the fruit is well preserved and easily recognizable almost in all varieties.

In contrast to the fruit, the leaves are less variable in shape. The margin, however, may vary from dentate to slightly lobate with mucronate or short-awned teeth or lobes. As in *Q. macrolepis* and *Q. brantii*, almost lyrate or deeply incised leaves may occur sporadically along with normal ones. *Q. ithaburensis* is not evergreen as stated by Schwarz (1936–37) and others. The period of leaf-fall and its duration may change from year to year according to the weather conditions of the season.

Q. ithaburensis Dcne. var. **ithaburensis** (Figures 1–5)

Q. ithaburensis Dcne. in Ann. Sci. nat. 2 Sér. 4: 348. 1835; Schwarz in Notizbl. 13 (116): 19. 1936 et Monogr. Atlas: t. 56. 1936–37.
Q. aegilops L. var. *ithaburensis* (Dcne.) Boiss. Fl. or. 4: 1172. 1879. *Q. aegilops* L. ssp. *ithaburensis* (Dcne.) Eig in Beihf. bot. Cbl. 51, Abt. 2: 228. 1933; A. Camus, Monogr. 1: 538. 1936–38.
Q. aegilops L. var. *pyrami* (Ky.) Boiss. Fl. or. 4: 1172. 1879. *Q. aegilops* L. ssp. *pyrami* (Ky.) A. Camus, Monogr. Atlas 1 Expl.: 43. 1934.
Q. pyrami Ky. Eichen: t. 3. 1862.
Q. aegilops L. var. *ungeri* (Ky.) Boiss. Fl. or. 4: 1172. 1879. *Q. aegilops* L. ssp. *ungeri* (Ky.) A. Camus, Monogr. Atlas 1, Expl.: 43. 1934.
Q. ungeri Ky. Eichen: t. 13. 1862 p.p.

TURKEY. S: Bulgardagh, eastern slopes of Armadschek above Ak Köpru, 1200 m, wood of *Q. libani* and *Q. ithaburensis*, *E* et *ZM* 387; prov. Adana, Dschebel Nur, *Ky* 20 (G); betw. Maraş and Göksun, n. Yemiş dag, 600 m, open *Pinus brutia* forest, *D* et *H* D/27515; env. d'Alexandrette, Ibouk-Sou — Batraken, argilo-calcaire, 120–150 m, *De* 340. SYRIA. S: Antilebanon, Zebdani, *Ky* 99 (G); castle of Banias, *Po* 272 (G). PALESTINE. UG: Env. of Yiftah, *ZM* 248. LG: Allonim, *ZM* 299. S: Env. of Hadera, *O* et *L* 926. SA: Betw. Shefeya and Bath Shelomo, *Gr* 923. DV: Env. of Daphne, the "Wood of the Ten", *Ka* 932.

The variety comprises in addition to the form described and illustrated by Kotschy and Camus also an array of other forms (Figures 1–5); among them are those described by Kotschy as *Q. ungeri* (p.p.) and *Q. pyrami*. These "species" do not even deserve to be separated as distinct varieties. As to *Q. pyrami*, Kotschy's specimens in Herbier Boissier and Herbarium Paris are identical both in leaf and fruit with some forms growing in Palestine together with typical *Q. ithaburensis*. Neither can one find in the description of *Q. ungeri* and *Q. pyrami* any significant difference between these two binomials or between them and *Q. ithaburensis*. Had Kotschy collected more specimens of *Q. ithaburensis* in Palestine, he would certainly have found his *Q. pyrami* and a series of other "species" on Mt. Tabor or near Mt. Carmel. Deeply cut leaves seen on his table 3 and his specimen No.20, are also found in "typical" *ithaburensis*, as also in *Q. brantii*. Ecologically, too, the plants considered *Q. pyrami* are very similar to *Q. ithaburensis*. Both inhabit alluvial plains and low hills within the southern part of the East Mediterranean territory. Camus (1934) and Schwarz (1936 b), who accorded *Q. pyrami* subspecific or specific rank respectively, seem to be unaware of the huge "Formenkreis" of *Q. ithaburensis* which is very poorly represented in European herbaria. As to *Q. ungeri*, I have seen specimens of this binomial in Herbier Boissier — Ky. 390, 394 and 387. While the former two are identical with typical *Q. look* (Ky. 172), the specimen Ky. 387 is identical with *Q. ithaburensis*. Moreover, Kotschy's table 13 of *Q. ungeri* most probably illustrates another taxon — perhaps one of the varieties of Q. *macrolepis*. *Q. ungeri* Ky. is, therefore, a *pro parte* synonym of *Q. look* and *Q. ithaburensis*.

Q. ithaburensis Dcne. var. **subcalva** Zoh. var. nov. (Figure 6)

Pars superior cupulae calva (squamis destituta). Cetera ut in var. *ithaburensi*.

PALESTINE. S: Env. of Hadera, sandy soil, *ZM* 1005. DV: Env. of Daphne, "Wood of the Ten", *S* 1004.

This is a rather rare variety distinguished by a lack of scales in the cupule's upper part; the middle and lower parts of the cupule are generally beset with recurved scales.

Q. ithaburensis Dcne. var. **dolicholepis** Zoh. var. nov. (Figure 7)

Squamae cupulae parce vel totae lineares vel filiformes, valde elongatae, 10–20 mm longae, liberae, erectae, patentes vel deflexae. Glandes et folia variabiles.

PALESTINE. UG: Yiftah, *ZM* 864. LG: Kefar Hassidim, *ZM* 845. S: Pardess Hanna, *O* et *L* 841. EP: Nahalal, *J. Weitz* 863. SA: Bath Shelomo, *O* et *L* 843. DV: Env. of Daphne, "Wood of the Ten", *S* 848.

This too is a most striking fruit variety. The free, very long and narrow cupular scales are erect, divaricate or recurved and appressed to the cupule. No other characteristics have so far been found to be coupled with this scale form.

Q. ithaburensis Dcne. var. **subinclusa** Zoh. var. nov. (Figure 8)

Fructus ovatus, 2.5–3 cm longus, 1.5–2 cm latus. Glans fere tota in cupula inclusa, squamae breves, adpressae, apice recurvae. Cetera ut in var. *ithaburensi.*

PALESTINE. DV: Env. of Daphne, "Wood of the Ten", *ZM* 383.

This variety is marked by its large fruits with glands almost enclosed in the cupule. In this character it parallels var. *eigii* of *Q. calliprinos*. That this character is not an "abnormal" feature which is connected with immaturity of the fruit, has been proved by the fact that the acorns of this variety germinated normally.

Q. ithaburensis Dcne. var. **calliprinoides** Zoh. var. nov. (Figure 9)

Cupula 6–10 mm longa et lata, squamae minutae, adpressae, lanceolatae, pubescentes; glans cupula duplo vel triplo longior, acuta, mucronata.

PALESTINE. LG: Tiv'on, *Sternlicht* 381.

This variety closely resembles *Q. calliprinos* in its fruits and is perhaps a hybrid between the latter and some form of *Q. ithaburensis*. Both alleged parental species occur here together.

All the varieties described above are mainly distinguished by their fruit and particularly by the shape of the cupule and its scales. There is another series of fruit forms, which have tentatively been included within var. *ithaburensis* only because they intergrade into one another. These fruits maintain their homogeneity on each individual tree, as against leaves' characters which, to a certain extent, vary from branch to branch according to position, age, etc. From our observation it seems that fruit characters are fairly constant at least in the first generation observed. No correlation has been found between cupule and leaf characters.

Many of the above varieties may occur together within the same population, but not infrequently a certain variety is dominating. It is mostly var. *ithaburensis* which occurs in almost all populations.

Q. ithaburensis is the southernmost representative of sect. *Aegilops*. It forms forests in the alluvial plains of Cilicia (S. Anatolia) and at lower altitudes of the Taurus Mts. Poor remnants of this forest type are also met with in the neighbourhood of Antakya (Amouk Valley) and in Mediterranean Syria and Lebanon. In Palestine it forms rather small forests in Lower Galilee. Its distribution and history have been studied by Eig (1933). While in Gilead, Golan, the Sharon Plain and Lower Galilee it still occupies considerable areas, its remnants in eastern Upper Galilee, in the Huleh Plain and Samaria are poor but still testify to its wide distribution in the not too distant past. Everywhere the Tabor oak forests are very thin and park-

like and rather poor in arboreal components. In the forests of Lower Galilee *Quercus ithaburensis* is often associated with *Styrax officinalis*, *Pistacia palaestina*, *Crataegus azarolus*, *Rhamnus palaestina*, *Calycotome villosa*, *Phlomis viscosa*, *Rubia olivieri*, *Bryonia multifida*, *Smilax aspera*, and many perennial and annual herbs.

Quercetum ithaburensis requires rather thermophilous Mediterranean conditions; it never occurs in Eu-Mediterranean exposures, where it is probably unable to compete with true Mediterranean evergreen maquis.

While in Palestine this species does not surpass altitudes above 500 m, it reaches 1000 m in southern Turkey. There is no doubt that this wide-ranged Tabor oak includes a series of ecotypes.

Quercus macrolepis Ky.

Upon examination of numerous specimens of what is commonly named *Q. macrolepis* and *Q. vallonea*, or collectively *Q. aegilops*, the author has come to the conclusion that there is no specific difference between the two. The epithet *macrolepis* has been held in preference over *vallonea*, because the form referred to as *Q. macrolepis* has a considerably wider area of distribution. The description of the latter binomial given by Kotschy and amended by Camus agrees with some of Kotschy's specimens and with his illustration on table 16.

What was called *Q. vallonea* by some authors is identical with *Q. macrolepis*, except for the fruit which approaches that of some varieties of *Q. ithaburensis*, i.e. the middle and upper cupular scales are woody, cylindrical, subulate or triquetrous, and usually strongly recurved. This is in accordance with Kotschy's description and with the illustration in Camus (Monogr. Atlas 1: pl. 55 ff. 1–8. 1934). Both *macrolepis* and "*vallonea*" trees may occur side by side. Also Walter (1956) considered both forms as *Q. macrolepis*.

Q. macrolepis Ky. var. **macrolepis**

Q. macrolepis Ky. Eichen: t. 16. 1862; Schwarz in Notizbl. 13 (116): 19. 1936 et Monogr. Atlas: t. 61. 1936–37.
Q. aegilops L. ssp. *macrolepis* A. Camus, Monogr. Atlas 1, Expl.: 44. 1934 et Monogr. 1: 531. 1936–38. *Q. aegilops* L. var. *macrolepis* Boiss. Fl. or. 4: 1171. 1879 (excl. syn.).

TURKEY. W: Prov. Çanakkale, distr. Eceabat, about 100 m, 605; distr. Ayvacik, Gemedere, about 350 m, 702; prov. Balikesir, Burhaniye, 250–300 m, *I* (Type VI); 30 km SW. of Balikesir on the way to Izmir, *ZM* et *ZD* 2562; prov. Izmir, distr. Bergama, Zeitindagi, 280 m, *I* (Type III); prov. Manisa, Hacihidir, 550 m, *I* (Type VII); Adala, 250 m, *I* (Type I, V, X); E. of Aydin, *ZM* et *ZD* 2571. C: Prov. Ankara, Hacikadun Valley, n. Keçiören, slopes, *D* 13191. S: Prov. Mugla, Minara, E. foot of Baba Dag, park like forest, *D* 13706.

Q. macrolepis Ky. var. **vallonea** (Ky.) Zoh. comb. nov.

Q. vallonea Ky. Eichen: t. 7. 1862; Schwarz in Notizbl. 13 (116): 19. 1936 et Monogr. Atlas: t. 62. 1936–37.
Q. aegilops L. ssp. *vallonea* (Ky.) A. Camus, Monogr. Atlas 1, Expl.: 42. 1934 et Monogr. 1: 536. 1936–38.

TURKEY. W: Distr. Bergama, env. of Emiralem, 54 m, *I* (type IX), and elsewhere in Lydia.

This is the typical form of *Q. vallonea* as understood by Kotschy in his exsiccata and by Camus (1936–38). It differs from var. *macrolepis* in its cupular scales which are narrow and more or less evenly recurved, the cupule being reminiscent of that common to some forms of *Q. ithaburensis*. It is not known whether this character is constant.

Q. macrolepis Ky. var. **ortholepis** Zoh. var. nov.

Differt a praecedenti squamis liberis, longis et angustis, erectis, etiam post fructus maturationem non recurvatis. Folia saepe dentato-lobulata vel profunde et grosse lobata.

Cupular scales erect, free, long and narrow. Leaves dentate-lobulate or deeply lobate.

TURKEY. W: Distr. Bergama, Emiralem, 25 m, *I* (Type IV); Kozak, 450–500 m, *I* (Type II). S: Prov. Mugla, distr. Fethiye, Wald Kabaagaç, ca 150 m, 648. C: Hacikadun valley n. Keçiören, N. of Ankara, 679.

In the area under review *Q. macrolepis* s.l. is limited mainly to the Aegaean province of western Anatolia with a few outposts further east. It forms park-like forests and has been extensively utilized since ancient times because of its tannin bearing fruit cupules. Much has been written about the "vallonea" tree and "vallonea" forests in Turkey and mention should be made of Inal (1959) who cites most of the literature. We have seen stands of this species on hills and alluvial plains in many places north and northeast of Izmir, as well as between Izmir and Denizli. In many cases single trees or stands are found also on cultivated land and often in fig and olive groves.

Generally, this species does not occur at altitudes exceeding 1000 m. It is to be supposed that vast stretches of intermountain valleys of Lydia which are to-day under cultivation were once occupied by "vallonea" forests.

Quercus ehrenbergii Ky. Eichen: t. 15. 1862

Schwarz in Rep. 33: 330. 1934; A. Camus, Monogr. 1: 529. 1936–38.

TURKEY. W: Prov. Balikesir, Edremit Wald, Yalasma, about 150 m, *C. Erhan* 721. S: Bulgardagh, eastern slopes of Armadschek above Ak Köpru, 1200 m, woods of *Q. libani* and *Q. ithaburensis*, *E* et *ZM* 361; prov. Adana, 740.

This species is very closely related to *Q. macrolepis* var. *vallonea*. The only character in which it differs markedly from the latter is the peculiar shape of its leaf which resembles that of *Crataegus orientalis*. It should, however, be noted that our sheet No. 361 contains two specimens, one with typical incised leaves, the other with less incised ones. The original description of the cupule must be somewhat modified as to include also specimens in which cupular scales remind of some forms of *Q. ithaburensis* var. *ithaburensis* There are few data on this species which seems to be rather rare and which deserves a more detailed study.

Quercus look Ky. Eichen: t. 21. 1862

Q. aegilops L. ssp. *look* (Ky.) A. Camus, Monogr. Atlas 1, Expl.: 43. 1934 et Monogr. 1: 550. 1936–38.

Q. ungeri Ky. Pl. exsicc. No. 172 (G) non Eichen: t. 13. 1862.

TURKEY. S: Bulgardagh, *Ky* 390, 394 (both G). SYRIA. S: Mt. Hermon, prope Rascheya, *Ky* 172 (G). LEBANON. Djebel Barouk, cèdres d'Ain-Zahlta, *J. Thiébaut* s. n.; Lebanon (without locality), *R. Habba!* 1075a; Lebanon (without locality), *M Fournier* 1048.

This species is among the least known in sect. *Aegilops*. Its description is based on two collections by Kotschy, No.172 (Mt. Hermon) and No. 53 (Hauran). Of these, the former can be referred to *Q. look*, as described by Kotschy, whereas the latter does not differ markedly from *Q. ithaburensis*. The examination of Kotschy's specimens in Herbier Boissier has shown that Nos. 390, 394 collected in Bulgardagh (Taurus), although differently named by Kotschy, are also identical with *Q. look* (type specimen: Ky. 172). This together with the later findings of Thiébaut (Lebanon, Djebel Barouk) and Habbal (No. 1075 a) have led me to the conclusion that *Q look* is a distinct species, although it is most probably a hybrid between *Q. libani* and *Q. ithaburensis*. In Zebdane (Antilebanon) all three taxa — *Q. ithaburensis*, *Q. libani* and *Q. look* occur. In Bulgardagh, where Kotschy's Nos. 390 and 394 were collected, both presumed parents of *Q. look* also occur. Until more information is obtained on this matter, Q. *look* should be retained at a specific rank and not synonymized with *Q. ithaburensis* (Schwarz, Monogr. Atlas: t. 56. 1936–37). It seems to me that *Q. libani* var. *brachyphylla* Bornm. may also be referred to *Q. look*, but I have not seen Bornmueller's specimen.

Quercus brantii Lindl.

This species differs from both *Q. macrolepis* and *Q. ithaburensis* by its leaves and fruit pattern. As against the latter two which occupy Mediterranean areas, *Q. brantii* is confined to the Irano-Armenian territory of the Irano-Turanian region. The variability of this species is reflected mainly in the size and shape of gland, cupule, and particularly to the shape, position and dimensions of the cupular scales. There is a striking trend toward regularity of leaf dentation although a lusus of lyrate blades as it sometimes occurs in *Q. macrolepis* and *Q. ithaburensis*, has also been found. The indumentum (densely or sparsely stellate-hairy above and yellowish-tomentous beneath) is also fairly constant throughout. A few varieties, though intergrading with one another, have been distinguished.

Q. brantii Lindl. ssp. **brantii** var. **brantii**

Q. brantii Lindl. ssp. *brantii* A. Camus, Monogr. Atlas 1, Expl.: 43. 1934 et Monogr. 1: 544. 1936–38.

Q. brantii Lindl. Bot. Reg. Append. Misc.: 41, N. 74. 1840; Schwarz in Rep. 33: 327. 1934.

TURKEY. E: 26 km S. of Malatya, *ZM* et *ZD* 3307. IRAQ. N: Distr. Zakho, n. the village Bursiki, 505 m, solitary trees in fields, *ZM* et *Du* 368; distr. Dohuk, env. of Sursink, 920 m, shady mountain slope, *F* et *Ev* 992; betw. Suwara Tuka and Amadia, 1000–1200 m, *E* et *F* 365; distr. Penjwin, Jebel Sebaran 1070 m, stony slope, *Quercetum brantii*, *E* et *F* 362; distr. Sulaimaniya, Qara Dagh, Kani-

tacht, 1440 m, *Quercetum brantii*, *E*, *F* et *ZM* 330a. IRAN. S: Betw. Shiraz and Kazerun, 10 km W. of Dasht-Arjan, about 6500 ft, *ZM* et *ZD* 9813.

Among the large amount of specimens examined, only a few can be included within the typical form as represented by Kotschy's specimens (Nos. 560, 561) and illustrated in his Eichen (t.31); a few other specimens of those deposited in Herbier Boissier (G) may also belong to this form.

Q. brantii Lindl. ssp. **brantii** var. **belangeri** (DC). Zoh. comb. nov.

Q. persica Jaub. et Sp. var. *belangeri* Alph. DC. in D. C.Prodr. 16,2: 48. 1864.

TURKEY. E: Prov. Elazig, Hazar Gölü, about 1135 m, level ground, n. mouth of stream, dominated by *Quercus*, *N* 475; prov. Urfa, N. slope of Karacadag, betw. Siverek and Diyarbakir, 1250 m, rocky basalt gulley, *D* et *H* D/28298. IRAQ. N. 26 km N. of Zakho, n. the village Bursiki, 680 m, *ZM* 325; env. of Zawita, 700–800 m, calcareous rocks, *Pinetum brutiae*, *ZM* 339; Pejar Mts., n. the village Bageir, 805 m, *ZM* 373; distr. Dohuk, env. of Sursink, 1220 m, rocks, *F* 375; betw. Suwara Tuka and Barash, forest of *Q. boissieri*, *E* 336; Ruvendiz gorge, n. Khalifan entrance, *E* et *ZM* 326; distr. Penjwin, Jebel Sebaran, 1070 m, *Quercetum brantii*, *E* et *F* 404; distr. Sulaimaniya, Mergapan, 1160 m, *ZM* et *A* 418; Qara Dagh, Kanitacht, 1440 m, *Quercetum brantii*, *E*, *F* et *ZM* 384.

This variety is the most common in Kurdistan. It is readily distinguishable from the afore-mentioned one by the long, linear or filiform, erect, recurved or deflexed upper cupular scales; they range from 8 to 18 mm or more in length. Their direction and degree of divergence, elsewhere a constant character, is in this as well as in other species of this section highly variable. The shape of the cupule is mostly semiglobular with a rounded or somewhat narrowed base. The proportion between gland and cupule also varies considerably and there are forms definitely intermediate between var. *belangeri* and var. *brantii* on the one hand and between the former and var. *persica* on the other.

Q. brantii Lindl. ssp. **brantii** var. **persica** (Jaub. et Sp.) Zoh. comb. nov.

Q. brantii Lindl. ssp. *persica* (Jaub. et Sp.) Schwz. in Notizbl. 13 (116): 19. 1936 p.p. et Monogr. Atlas: t. 60. 1936–37.
Q. persica Jaub. et Sp. Illustr. 1: 109, t. 55. 1842; A. Camus, Monogr. 1: 526. 1936–38.

IRAQ. N: Jebel Sebaran, betw. Sulaimaniya and Penjwin, n. Tankabiya River, 1070 m, *E*, *ZM* et *F* 124; distr. Sulaimaniya, Qara Dagh, Kanitacht, *Quercetum brantii*, 1440 m, *E*, *F* et *ZM* 414.

This variety differs from the former by its short, slightly recurved scales and turbinate cupule. But there are all possible transitions between it and var. *belangeri*, and future studies will certainly discard this taxon. Only two of the many specimens distributed by Kotschy as *Q. persica*, agree with the description and the illustrations by Jaubert and Spach, and by Kotschy. Thus, for instance, the specimens Ky. 394 and Ky. without number from Amadia, cited by Boissier, do not belong to this variety. Also the specimens: Strauss-Sultanabad, Hausskn.-Territer, cited by Schwarz (Atlas: t. 60. 1936–37) as *Q. brantii* Lindl. ssp. *persica* do not belong to this taxon.

It is now clear that this particular form is exceedingly rare and no doubt scattered among the other forms in southwestern Iran wherefrom *Q. persica* has been described. The only fruiting specimens of *Q. brantii* collected by us in southern Iran in 1960 belong to var. *brantii*.

Q. brantii Lindl. ssp. **brantii** var. **marasiensis*** Zoh. var. nov.

Differt a var. *belangeri* foliis grosse dentatis, dentibus late triangularibus, minus mucronatis, nervis paucioribus. Squamae longae, filiformes, rectae vel deflexae.

Differs from var. *belangeri* by the broad-triangular, toothed, less mucronate leaves with fewer nerves. Cupular scales long, filiform.

TURKEY. S: S. of Maraş, env. of Fevzipaşa, plains with scattered trees, *ZM* et *ZD* 3210; about 20 km S. of Gölbasi, about 1000 m, single trees in the field, *ZM* et *ZD* 3029, E: Prov. Malatya, distr. Adiyaman, 17 km nach Gölbasi, vulkanische Felsen, *B* 92.

This variety is intermediate and seemingly a hybrid between *Q. brantii* and *Q. ithaburensis*. This is obvious from the morphology of its leaf and fruit, as also from its being confined to a meeting area of the above two species.

Q. brantii Lindl. ssp. **brantii** var. **minuta** Zoh. var. nov.

Fructus minor, 10–15 mm longus, 12–15 mm latus, squamae superiores cupulae longae, deflexae, ceterae breviores, recurvae; glans cupula sesqui longior.

Fruits very small, 10–15 mm long, 12–15 mm broad; gland 1.5 times as long as cupule.

IRAQ. N: Distr. Sulaimaniya, Qara Dagh, env. of Kanitacht, 1440m, *Quercetum brantii*, *E* et *F* 383.

Q. brantii Lindl. ssp. **oophora** (Ky.) Schwz. var. **oophora**

Q. brantii Lindl. ssp. *oophora* (Ky.) Schwz. in Notizbl. 13 (116): 19. 1936 p.p. et Monogr. Atlas: t. 59. 1936–37.

Q. brantii Boiss. Fl. or. 4: 1173. 1879 p.p.

Q. oophora Ky. Eichen: t. 26. 1862; A. Camus, Monogr. 1: 546. 1936–38.

IRAQ. N: Distr. Dohuk, env. of village Sursink, 920 m, *F* et *Ev* 385; betw. Suwara Tuka and Barash, 1100–1220 m, *Quercetum libani*, *E* 388; distr. Sulaimaniya, Qara Dagh, Wadi Jaafaran, 1000 m, n. water, *E* et *F* 384.

I do not agree with Boissier who synonymized *Q. oophora* with *Q. brantii*, neither with Schwarz (Monogr. Atlas: t. 59. 1936–37) who referred to it specimens typical of var. *brantii* or other taxa. It should be emphasized that true "*oophora*" plants have not only very large fruits but also more lanceolate leaves which rather closely approach those of *Q. libani*. Camus (Monogr. 1: 547. 1936–38) seems to be right in suggesting *Q. oophora* as a hybrid form between *Q. brantii* and *Q. libani*. All the three grow together in Iraqian Kurdistan, sometimes even in the same stand.

Q. brantii Lindl. ssp. **oophora** (Ky.) Schwz. var. **stenolepis** Zoh. var. nov.

Cupula ut in var. *oophora*, usque ad 3 cm diam. sed squamae longissimae, usque ad 25 mm longae, rectae vel deflexae, lineares vel filiformes.

Cupule as in var. *oophora* up to 3 cm in diam., but scales free, much longer, up to 25 mm long.

* After an ancient Assyrian name of the town Maraş.

IRAQ. N: 26 km N. of Zakho, 680 m, *E* 412; distr. Dohuk, 900–1000 m, *Quercetum boissieri*, *ZM* 410; distr. Sulaimaniya, env. of Pir-i-Mukurun, 1100–1200 m, *ZM* et *A* 406.

This variety has strikingly large fruits not unlike those of var. *oophora*, but with linear, very long, free, erect or deflexed cupular scales; in other respects it closely approaches var. *belangeri*.

Q. brantii forests occupy large stretches in the Irano-Armenian mountain belt of Anatolia, Iraq and Iran. Geographically, they form the southernmost spur of the wide Eurosiberian deciduous forest belt but are Irano-Turanian in composition. They are surrounded by steppe vegetation and many species of the latter occur among the trees or as underwood in these forests.

While in the northern and northwestern part of their distribution area *Q. brantii* forests are fairly rich in arboreal components, the forests in southwestern Iran are very meagre in that respect.

A record taken in Iraqian Kurdistan from the district of Dohuk (env. of Suwara Tuka, eastern slope) comprises among others, the following species: *Q. brantii*, *Q. boissieri*, *Juniperus oxycedrus*, *Cerasus microcarpa*, *Pyrus syriaca*, *Crataegus heterophylla*, *Prunus divaricata*, etc. In Kurdistan, pure *Q. brantii* forests are almost non-existent, except in southern and eastern exposures; on flat mountain tops and in other exposures this oak is often accompanied or overwhelmed by *Q. boissieri*. In such favourable exposures *Q. libani* is also present. In typical S. Iranian *Q. brantii* forests, such as occurring between Shiraz and Kazerun, the following species were noted among others: *Q. brantii*, *Pistacia atlantica*, *Acer cinerascens*, *Amygdalus scoparia*, *Colutea persica*, *Berberis integerrima*, *Lonicera persica*, *Prunus microcarpa*, *Daphne angustifolia*.

On the base of the material so far examined, the following phylogenetical relations can be assumed for the species of sect. *Aegilops*:

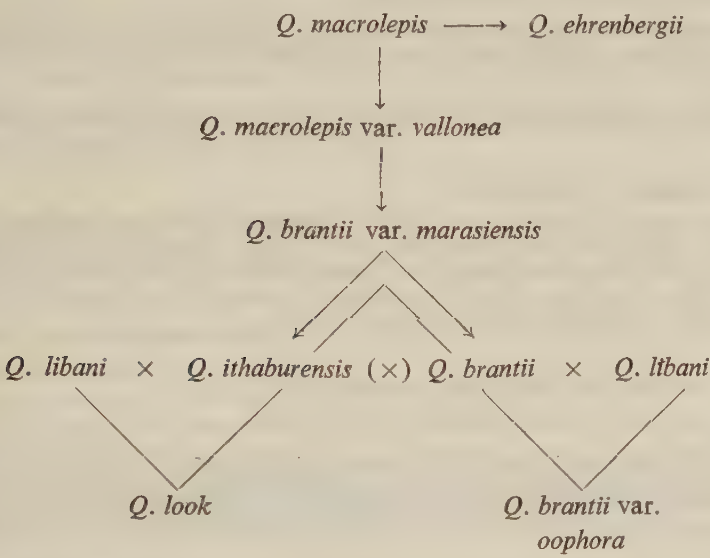
Q. macrolepis should be considered as the most primitive of this section for the following reasons: Firstly, the high irregularity of the leaf margin may indicate primitiveness in leaf characters, suggesting relations with sect. *Cerris*. Secondly, the very large acorn (perhaps the largest among Eurasian species) with its large, flat, lanceolate, leaf-like scales suggests a very primitive stage of the oak fruit in general. The disjunct distribution of this taxon in the Mediterranean western Anatolia, Greece, Macedonia and Italy also points to its comparatively higher age.

Q. ehrenbergii is probably a side branch of the "macrolepis" form cluster. The broad-ovate, strongly lobate *Crataegus*-like form of the leaf has become more or less fixed in this species, the distribution area of which is extremely limited. The sporadic occurrence of a less lobate leaf may be taken as an intimation of such a development.

Var. *vallonea* may be considered, at least as regards the fruit form, as a link between *Q. macrolepis* and the two other important species of the section, namely *Q. brantii* and *Q. ithaburensis*, which occupy rather large areas in the Middle East. While the former inhabits the eastern portion of southwestern Asia (the Irano-Armenian

territory), the area of the latter forms the southernmost spur (Cilicia — Palestine) of the East Mediterranean territory. A connecting form between the two may be seen in var. *marasiensis*, which is somewhat intermediate between "vallonea" and "brantii" or between former and the "ithaburensis" forms or a hybrid between the "brantii" and "ithaburensis" forms; it also occupies an area intermediate between those of the respective taxa.

Q. look, as has been pointed out above, is presumably a hybrid between *Q. ithaburensis* and *Q. libani*, while var. *oophora* of *Q. brantii* is a supposed hybrid between *Q. brantii* and *Q. libani*. The following diagram may illustrate the above assumption:



Quercus libani Oliv.

Q. libani is one of the most clearly delimited species. Only a few varieties have been distinguished so far on leaf characters.

Q. libani Oliv. var. **libani**

Q. libani Oliv. Voy. Emp. oth. 2: 290. 1804 et Atlas: t. 32. 1802; Schwarz in Notizbl. 13 (116): 19. 1936 et Monogr. Atlas: t. 63. 1936–37; A. Camus, Monogr. 1: 517. 1936–38.

TURKEY. S: Bulgardagh, *Ky* 381 (G). Akher Dagh, Maraş to Zeytun, 3500 ft, dense scrub to 12 ft tall, *C. K. Bull* 993: Amanus Mts., Col de Gueny Bel (?), rochers calcaires, 1400–1500 m, *De* 1053. E: Prov. Bingöl, n. Solhan on hillsides, *D* et *P* 24791. IRAQ. N: Distr. Dohuk, mountains above Suwara Tuka, 1100 m, *ZM* et *A* 1064; ascent from Mt. Zangalu, betw. Dohuk and Amadia, bare spot in *Quercetum boissieri*, *ZM* et *A* 1091; betw. Suwara Tuka and Barash, 1100–1220 m, *E* 1083: Ruvendiz gorge, n. Alana Su, 680 m, rocky place, *E* et *ZM* 1081; betw. Penjwin and Douleh, banks of a rivulet, *E* et *F* 1077.

The specimen of Penjwin should be considered as an intermediate form between *Q. libani* and *Q. brantii* ssp. *oophora;* it has slightly recurved oupular scales and more pubescent leaves.

Q. libani Oliv. var. **libani** f. **deflexa** Zoh. f. nov.

Squamae cupulae apice paulum recurvae; cetera ut in var. *libani*.

Cupular scales somewhat recurved at apex.

IRAQ. N: Distr. Dohuk, betw. Suwara Tuka and Barash, forest of *Q. boissieri*, *E* 1067; env. of the village Sursink, deep shady gorge, rocks, 920 m, *F* et *Ev* 1077a (type !); distr. Penjwin, Jebel Sebaran, Tankabiya River, *E* et *F* 1084.

Q. libani Oliv. var. **inermis** Zoh. var. nov.

Dentes foliorum mutici, nec ut in typo mucronato-aristati; cetera ut in var. *libani*.

Teeth of leaves muticous, not mucronate-awned.

LEBANON. N: Wadi Moul Abu Djerra (Wadi Fissene) E. of Tripoli, 1415 m, rocky soil, *Quercetum libani*, *Bot. Dept.* 1353; betw. Nebi el Nassoura and Ain Fissene, 1270–1520 m, *Stud. Rer. nat.* 1335.

Q. libani Oliv. var. **pinnata** Hand.-Mazz. in Ann. k. k. naturh. Hofmus. Wien 26: 128. 1912

A. Camus, Monogr. 1: 520. 1936–38.

IRAQ. N: Distr. Dohuk. mountains above Sursink, 900–1000 m, *Quercetum boissieri*, *ZM* 1037; betw. Penjwin and Douleh Sur, permanent brook, *E* et *F* 1039; Ahmed Kulvan, 1230 m, *E* et *F* 1036. LEBANON. N: Wadi Moul Abu Djerra, E. of Tripoli, bottom of Wadi Fissene, 1415 m, rocky soil, *Quercetum libani*, *Bot. Dept.* 1396; betw. Nebi et Nassoura and Ain Fissene, 1270–1520 m, *Stud. Rer. nat.* 3891. — This seems to be a lusus not a variety.

Q. libani Oliv. var. **eigii** (A. Camus) Zoh. comb. nov.

Q. regia Lindl. var. *eigii* A. Camus, Monogr. 1: 523. 1936–38.

TURKEY. W: Prov. Balikesir, Savaş Tepe, Marmar, about 350 m, *Ko* 626; Berg Çatal dag, maquis, *K* 102. S: Prov. Mugla, distr. Fethiye, Zedern Wald bei Kücükaliher, *K* 109; Bulgardagh, eastern slopes of Armadschek above Ak Köpru, woods of *Q. libani* and *Q. ithaburensis*, 1200 m, *E* et *ZM* 1044; env. of Mersin, *E* et *ZM* 385. E: Prov. Siirt, Pervari, Nepile Wald, about 850 m, *K* 80.

Q. trojana which I did not see from the reviewed area should be very close to *Q. libani*, especially to the form with partly recurved cupular scales (f. *deflexa*). The relations between the species are very uncertain. It is doubtful whether these two binomials can be kept apart.

Q. libani has a disjunct area of distribution. One portion of the area comprises the Irano-Armenian mountains (Armenia, Kurdistan), the other — the western-Anatolia, Taurus, Amanus, Cassius, Nusairy Mts. and Lebanon. This type of discontinuity is typical of a series of other Mediterranean — Irano-Armenian orophytes.

Q. libani usually forms mixed forests. In the Iraqian Kurdistan these forests occupy the western exposures of the mountains which are ecologically the most favourable ones. Here it occurs at an altitude of 1100–1230 m. In one record we noted this tree in association with *Q. boissieri*, *Crataegus heterophylla*, *Juniperus oxycedrus*, *Cotoneaster nummularia*, *Prunus microcarpa*, *P. divaricata*, *Sorbus aria*, *Q. brantii* and *Rhus coriaria*. In northern Lebanon *Q. libani* is met with up to an altitude of 1500 m, but rarely forms forests. It has been found in association with

Q. boissieri, *Q. calliprinos*, *Phillyrea media*, *Styrax officinalis*, *Pistacia palaestina*, *Prunus ursina*.

Quercus castaneaefolia C.A.M. Verz. Pfl. Cauc.: 44. 1831
Schwarz in Notizbl. 13 (116): 20. 1936.
Q. castaneaefolia ssp. *eu-castaneaefolia* (C.A.M.) A. Camus, Monogr. 1: 552. 1936–38.
IRAN. N: Caspian coastal region, env. of Nowshahr, *ZM* et *ZD* 891.

This is a beautiful tall tree which is sometimes dominant in the Hyrcanian forests of northern Iran. In the vicinity of Chalus it grows in association with *Alnus subcordata*, *A. glutinosa*, *Cornus australis*, *Carpinus orientalis*, *Tilia rubra*, *Parottia persica*, *Zelkova crenata*, *Pterocarya fraxinifolia*, *Punica granatum*, *Gleditschia caspica*, *Diospyros lotus*, *Periploca graeca*, etc., all at an altitude of 300 m. Higher up we come across some stands of this oak with only very few associates. It occurs here from sea level up to about 1800 m (Bobek 1951).

Quercus cerris L. Sp. Pl.: 997. 1753
A. Camus, Monogr. 1: 589. 1936–38.

Q. cerris L. var. **austriaca** (Willd.) Loudon, Arbor. 3: 1848, pl. 7, f. 69 g. 1839
A. Camus, Monogr. 1: 597. 1936-38.
Q. cerris L. ssp. *austriaca* (Willd.) Schwz. in Rep. 33: 328. 1934.
Q. austriaca Willd. Sp. Pl. 4: 454. 1805.

TURKEY. N: Env. of Istanbul, Çatalca, Dorf Alaton, *C* 133; prov. Bolu, Düzce — Hendek, 200 m, about 15 km SE. of Sinop, *Q. calliprinos — Carpinus orientalis* stand, *ZM* et *ZD* 3164. S: Amanus Mts., Jebel Musa, betw. the village Celdrin and Bujukaba, 650–720 m, *E* et *ZM* 3388.

Q. cerris L. var. **haliphloeos** (Lam.) Lam. et DC. Fl. fr. ed. 3,3: 311. 1805
A. Camus, Monogr. 1: 598. 1936–38.
Q. haliphloeos Lam. Encycl. 1: 718. 1786.

TURKEY. N: Prov. Kirklareli, distr. Dermiköy, 655. W: Prov. Bursa, Mustafa Kemal Paşa, 578.

Q. cerris L. var. **tournefortii** (Willd.) C. Koch in Linnaea 22: f. 321. 1849
A. Camus, Monogr. 1: 599. 1936–38.
Q. cerris L. ssp. *tournefortii* (Willd.) Schwz. in Rep. 33: 329. 1934.
Q. tournefortii Willd. Sp. Pl. 4: 453. 1805.

TURKEY. N: Prov. Kirklareli, distr. Çorlu, *B* 84; prov. Zonguldak, Yayla, about 800 m, *N. Altinisik* 612; prov. Sinop, Çingal Dag, 1700–1900 m, forest of *Q. cerris*, *ZM* et *ZD* 2478; S. of Amasya, 400–600 m, remnants of *Q. cerris — Carpinus orientalis* forest, *ZM* et *ZD* 2024; about 20 km S. of Tokat, *Q. cerris – Carpinus orientalis* forest, *ZM* et *ZD* 3142. W: Prov. Bilecik, distr. Osmaneli, Adliya Köyü, Wald Karahuyu, about 750 m, *N. Arikan* 608. S: NE. of Beyşehir, basalt soil, 1100–1200 m, *ZM* et *ZD* 2406; prov. Antalya, betw. Kargichai Bridge and Beydam, 1200 m, *D* 14252; env. of Gözne, NW. of Mersin, 1000–1100 m, maquis, *E* et *ZM* 921; Amanus Mts., Jebel Musa, betw. the village Celdrin and Bujukaba, 650–720 m, *E* et *ZM* 925. LEBANON. N: Env. of Fnediq, 1350 m, rocky soil, *Quercetum cerridis*, *Bot. Dept.* 922. S: Djezzine, small wadi in *Pinus pinea* forest, *F* 923.

Q. cerris L. var. **pseudocerris** Boiss. Fl. or. 4: 1171. 1879

A. Camus, Monogr. 1: 600. 1936–38.

TURKEY. N: Betw. Kastamonu and Sinop, forest of *Pinus sylvestris*, 1500–1900 m, *ZM* et *ZD* 2390; prov. Sinop, Çingal Dag, forest of *Q. cerris*, 1700–1900 m, *ZM* et *ZD* 2474; S. of Amasya, remnants of *Q. cerris —Carpinus orientalis* forest, 400–600 m, *ZM* et *ZD* 2026; about 20 km S. of Tokat, *Quercus — Carpinus* forest, *ZM* et *ZD* 3143. W: Prov. Çanakkale, distr. Yenice, Susuz Ormani, about 300 m, 708; prov. Balikesir, Edremit¦Berg, Kazdagi (Ida), *K* 99; 300 m above Bursa, forest and clearings of *Q. infectoria*, *ZM* et *ZD* 2039; prov. Kütahya, Sabuncupinar, Berg Türkmen, 757; prov. Afyon, distr. Sinanpaşa, Çayhisar, *H. Sanli* 607. C: Prov. Ankara, Hacikadun Tall, 687. S: Prov. Mugla, distr. Fethiye, Zedern Wald bei Kücükaliher, *B*, *W* et *K*; 35 km NE. of Beyşehir, basalt soil, border forest, 1100–1200 m, *ZM* et *ZD* 2405; prov. Antalya, Tahtali — Daribükü", ca 1400 m, *K* et *D* 126; prov. Nidge, Hasan Dag, below Taspinar Y., 1900 m, *D*, *Do* et *Ce* 19015; env. of Gözne, NW. of Mersin, 1000–1100 m, *E* et *ZM* 389; distr. Elbistan, Nürühak — Kapidere, *D*, *Do* et *Ce* 20410; about 20 and 30 km S. of Gölbasi, *ZM* et *ZD* 9215, 3325; Amanus Mts., Jebel Musa, betw. Col de Celdrin and Bithias, 600–700 m, *E* et *ZM* 924. LEBANON. N: Env. of Fnediq, 1350 m, rocky hill, *Bot. Dept.* 952. S: Djezzine, small wadi in *Pinus pinea* forest, *F* 521.

The varietal subdivision of this species is not satisfactory and is recorded here tentatively only. A more critical study will probably discard a part of these varieties.

Q. cerris is very common especially in the Mediterranean part of the area, while it is lacking altogether in the Hyrcanian sector, in Kurdistan and in the Zagros Mts. It often occurs together with other oak species, e.g. with *Q. calliprinos*, *Q. boissieri* in the Lebanon, Taurus and Amanus mountains), with *Q. boissieri* (Anti-taurus), *Q. pubescens* (Taurus, the Euxinian and Sub-Mediterranean mountains), *Q. hartwissiana* (N. Anatolian mountains), *Q. frainetto* (N. Armenia), etc.

Forests of *Q. cerris* occur in several variants. Some of them may be mentioned here.

The *Quercetum cerridis* of Uludag (Bithynian Olympus) is mixed with scattered trees of *Castanea vesca*, *Q. hartwissiana* and *Pinus nigra*. Between Balikesir and Izmir *Q. cerris* may form almost pure stands or may be mixed with other trees, e.g. *Phillyrea media*, *Juniperus oxycedrus*, *Pyrus elaeagrifolia*, *P. syriaca*. Here we also found *Pinetum brutiae* with *Q. cerris* as underwood. Under true Mediterranean conditions *Q. cerris* is accompanied by maquis which no doubt penetrated into the area originally occupied by pure *Quercetum cerridis* and later affected by man. Under Sub-Mediterranean conditions, such as on the northern outskirts of the Cilician Taurus facing the Anatolian steppe we saw *Q. cerris* forest harbouring *Pyrus syriaca*, *Cotoneaster nummularia*, *Q. boissieri*, *Jasminum fruticans*, *Prunus* spp., *Pyrus elaeagrifolia*, *Pistacia palaestina*, *Juniperus oxycedrus*, *J. excelsa*, *Berberis cretica*.

On the southern slopes of the Taurus and also in the Amanus mountains, *Q. cerris* is met with both as a high forest and as underwood in *Pinus brutia* and *P. nigra* forests. It occurs here at 500–600 m above sea level and ascends the mountains up to 1500 m (Achagi Zarkoun). In northern Syria *Q. cerris* forests are present in the district of Latakia (Nusairy Mts.). In the Lebanon mountains the *Q. cerris* forests have been largely destroyed but remnants of them still exist. In one of such remnants (near the village of Fnediq) we noted the following associates of *Q. cerris*: *Juniperus oxycedrus*, *J. excelsa*, *Q. calliprinos*, *Q. infectoria*, *Crataegus monogyna*, *Prunus ursina*, *Styrax officinalis*, etc.

Quercus ilex L. Sp. Pl.: 995. 1753

Schwarz in Notizbl. 13 (116): 21. 1936; A. Camus, Monogr. 2: 37. 1938–39.

TURKEY. N: Üsküdari, s.n. S: Prov. Mugla, Fethiye nach Kemer, *K* 111; Wald Sarniç, about 300 m, 647; prov. Isparta, Sütcüler, about 600 m, 726.

In the area under review this species is rather rare. It is reported only from western and northwestern Turkey where it mostly grows under Eu-Mediterranean conditions, often together with *Q. calliprinos*. We did not encounter this species on our travels through Turkey.

Quercus coccifera L. Sp. Pl.: 995. 1753

Kotschy, Eichen: t. 29. 1862; Alph. De Candolle in DC. Prodr. 16, 2: 52. 1864; A. Camus, Monogr. 1: 435. 1936–38.

TURKEY. N: Prov. Istanbul, Sile to Koyü, *I. Bandirmalioglu* 677. W: Prov. Izmir, 7 km S. of Selçuk, *ZM* et *ZD* 3491; env. of Denizli, steppe forest, *ZM* et *ZD* 3499. S: Auf Bergen, SW. von Akşehir, 1300 m, *K* 75; prov. Antalya, bei Kemer Schlucht "Kesme bogazi", *K* et *D* 122; prov. Adana, distr. Osmaniye, Berg Gavur dag im *Pinus* Wald, about 400 m, 94.

A few data only are recorded here on this species of which I have seen comparatively little material. Because of lack of fruits I did not try to divide it into varieties. Some of the specimens seem to be somewhat intermediate between this species and *Q. calliprinos*.

In the environs of Denizli and Izmir both species probably occur together. The specimens recorded here from Denizli form very low (30–40 cm high) but broad (1–2 m in diameter) shrubs. Nowhere did I find it forming typical maquis in the area reviewed.

Quercus calliprinos Webb, It. hisp.: 15. 1838

Oersted in Vidensk. Selsk. Skrift. 5 Ser. Afd. 9, Bd. 6: 357. 1871–72; Alph. De Candolle in DC. Prodr. 16, 2: 54. 1864; A. Camus, Monogr. 1: 451. 1936–38.

The question of separating this species from *Q. coccifera* L. has been discussed by several authors. While Boissier (1879), Schwarz (1934) and others considered this species one of the varieties of *Q. coccifera*, others, like De Candolle (1864), Oersted (1871–72), Camus (1936–38), Wenzig (1887), retained *Q. calliprinos* at its specific rank. The present author has examined hundreds of specimens of what is called *Q. calliprinos* from the East Mediterranean and also material of true *Q. coccifera* from the West Mediterranean. Despite the transitions met with in the meeting areas of the respective species, and despite some parallel variation occurring in both of them, there are morphological and ecological differences between the two which justify the keeping apart of these species. A few of these differences are given here (Table I).

TABLE I

Differential characters of Q. calliprinos *and* Q. coccifera

Q. calliprinos	*Q. coccifera*
1. Leaves generally oblong to lanceolate, rarely ovate; length: width = 2–3: 1.	1. Leaves mostly broad-ovate to ovate, rarely oblong; length: width = 1.5–2: 1.
2. Leaf margin not cartilaginous, entire or furnished with more or less approximated teeth tapering into short, erect, sometimes appressed spines or mucros.	2. Leaf margin more or less cartilaginous, furnished with more or less remote, abruptly divaricating or spreading spines.
3. Buds generally more or less tomentose.	3. Buds mostly more or less glabrous.
4. Female flowers always with tomentose hairy scales and 3–4 stigmas.	4. Female flowers mostly with glabrous scales and 5–6 stigmas.
5. Cupular scales mostly fairly long (4–10 mm), oblong to lanceolate and linear, less appressed to cupule, with rather long, erect or recurved, deflexed, not spinescent tips.	5. Cupular scales generally short (1.5–3 mm), compact, mostly with very short, triangular, spreading and spinescent tips.
6. Glands mostly more or less rounded and mucronate at apex.	6. Glands mostly tapering at apex.

These distinguishing characters are not strictly exclusive but are in ensemble quite sufficient to differentiate the bulk of individuals of the two species from one another. In addition, the mainly West Mediterranean *Q. coccifera* is mostly a low shrub and a component of the garigue formation and not forming true maquis. *Q. calliprinos* on the other hand is the main component of the generally 3-4 m high maquis in most of the East Mediteranean countries, and is able to grow into a fairly high tree when unaffected by man.

The meeting area of these species is rather large and irregularly indented. Here one may find both species side by side and also hybrids and introgressed forms. This happens in Greece, Cyprus and some places of western Anatolia. Anyhow, there is no difficulty to distinguish between specimens from the distal parts of both areas.

The variability of *Q. calliprinos* is considerable but is mainly confined to fruit characteristics. Variation in leaf shape is less constant. Camus (l.c.) and De Candolle (l.c.) have distinguished a long series of varieties in this species. To these one could add another series of no less distinct varieties from among the Palestine oaks alone. But as one examines larger amounts of material one sees most of these taxa merging into one another. Therefore only a few varieties differentiated by qualitative, more or less discontinuous characteristics of the cupule are recorded here. It should be emphasized that on each tree examined I found strictly uniform fruits.

Q. calliprinos Webb var. **fenzlii** (Ky.) A. Camus in Bull. Soc. bot. Fr. 80: 355. 1933 (Figure 10)

Q. fenzlii Ky. Eichen: t. 24. 1862.

TURKEY. S: Prov. Mugla, Fethiye, 604; prov. Antalya, betw. Kargi Chai and Balister, 1100 m, *D* 14235; prov. Adana, distr. Misis, Nur Dag, above Kizildare, 200 m, rocky slopes, *D* et *H* D/26719; prov. Maraş, about 30 km S. of Gölbasi, forest, *ZM* et *ZD* 3326; prov. Hatay, distr. Antakya, n.

Şenköy, 1000 m, dominant shrub, *D* et *H* D/27195. LEBANON. S: Hammana, shade of wall, 749. PALESTINE. J: Deir es Sheikh, *R. Gabrielith* 142 K. A: Betw. Tafile and Idna, 100 km S. of Amman, *A. Gur* 396.

Q. calliprinos Webb var. **eucalliprinos** Alph. DC. in DC. Prodr. 16, 2: 55. 1864 (Figure 11)

A. Camus, Monogr. 1: 456. 1936–38.

Q. calliprinos Webb var. *dispar* Ky. It. No. 422. 1866; Oersted in Vidensk. Selsk. Skrift. 5 Ser. Afd. 9, Bd. 6: t. 5. 1871–72.

Q. pseudococcifera Labill. Ic. Pl. Syr. Dec. 5: 9, t. 6, f. 1. 1812, non Desf. Fl. atl. 2: 349. 1798–1800.

TURKEY. W: 25 km E. of Aydin, border of hills, *ZM* et *ZD* 2572; 20 km W. of Denizli, grey calcareous soil, *ZM* et *ZD* 3528. S: Prov. Mugla, distr. Fethiye, Wald Sarniç, about 300 m, 647; prov. Isparta, Sütcüler, about 600 m, 726; env. of Gözne, NW. of Mersin, 1000–1100 m, maquis, *E* et *ZM* 801; Amanus Mts., De Kinz Kindja à Kara Ylay, calcaires et gabbros, 800–1200 m, *De* 774; env. of Souklouk, n. Alexandretta, 800–850 m, devastated forest, *E* et *ZM* 386; Ziareth Dagh, env. of Belled es Sheikh, *Quercetum boissieri* and *Q. calliprini*, *E* et *ZM* 395. SYRIA. N: Armenas, 300 m, *De* 725; about 35 km S. of Latakia, *Pinetum halepensis*, 794, Djebel Arbain, env. of Eriha, field borders and rocks in a cut-down *Quercetum*, *E* et *ZM* 559. S: Djebel Druze, n. the village Soulem, N. of Suweida, *E* et *ZM* 811; El-Kefr, *Quercetum calliprini*, *E* et *ZM* 814. LEBANON. N: Betw. Batroun and Tripoli, slopes of mountains, *E* et *ZM* 688; betw. Naba Dilbi and Teuran, 500–600 m, *Bot. Dept.* 783; Wadi Fissene n. the village Fissene, 1120 m, rocky soil, *Quercetum calliprini*, *Bot. Dept.* 782; env. of Hawara, E. of Sir, 1005 m, rocky soil, *Quercetum calliprini*, *Bot. Dept.* 785; Hasroun, slopes of a deep wadi, 795. S: Djezzine, destroyed *Quercetum calliprini* maquis, *F* 749; Jodeida *F* 580. PALESTINE. UG: Hanita, top of hill, 398 m, *F* 591. LG: Peak of Mt. Tabor. CA: Muhraka, *Q. calliprinos* — *Q. boissieri* maquis, *F* 560. EP: Nahalal forest, *E* 523. SA: Jenin 141 d. J: 21 km from Jerusalem to Shaar Hagai, *F* 534; Hebron, Russian Monastery, 594. G: Env. of Jarash, *F* 730.

This is the most common variety of *Q. calliprinos*. In the Judaean Mts. it sometimes occurs exclusively and if not exposed to browsing often attains the size of a tall tree. The very old "Abraham's Oak" in the vicinity of Hebron belongs to this variety.

Q. calliprinos Webb var. **palaestina** (Ky.) Zoh. comb. nov. (Figure 12)

Q. calliprinos Webb var. *arcuata* Ky. ex Alph. DC. in DC. Prodr. 16, 2: 56. 1864; A. Camus, Monogr. 1: 457. 1936–38.

Q. coccifera L. var. *palaestina* (Ky.) Boiss. Fl. or. 4: 1170. 1879.

Q. palaestina Ky. Eichen: t. 19. 1862.

TURKEY. S: NW. of Mersin, env. of Gözne, 1000–1100 m, maquis, *E* et *ZM* 668; betw. Gaziantep and Adana, E. side of summit of Amanus, about 1200 m, stony slopes, oak scrub, *N* 825; Amanus Mts., Beylan, gabbros de serpentines, 500–600 m, *De* 771; Kavailana n. Alexandretta, remnants of *Pinetum halepensis*, *E* et *ZM* 666. CYPRUS. Platres, about 1200 m, together with *Q. boissieri*, *F* 338. SYRIA. S: Mt. Hermon, Shibbah, *T. Kushnir* 662. LEBANON: Without locality, *R. Habbal* 573. N: Betw. Naba Dilbi and Teuran, 500–600 m, *Bot. Dept.* 674. S: Djezzine, rocky and gravelly slope, maquis, *F* 665. PALESTINE. LG: Nazareth 145. CA: Mt. Carmel n. Haifa, slopes of wadi, stony places, *E* et *Faktorovsky* 663. EP: Nahalal, maquis, *N. Naftolsky* 664. J: Kiryat Anavim, *N. Naftolsky* 642.

Q. calliprinos Webb var. **eigii** A. Camus in Bull. Soc. bot. Fr. 80: 355. 1933 (Figure 13)

A. Camus, Monogr. 1: 458. 1936–38.

Q. calliprinos Webb var. **subglobosa** Zoh. var. nov. (Figure 14)

Cupula subglobosa, 2.5–3 cm diam. Glans tota in cupula inclusa; squamae mediae lineari-lanceolatae, paulum recurvae, superiores filiformes, deflexae.

Cupule globular, 2.5–3 cm in diam. Gland wholly included in the cupule; middle cupular scales slightly recurved, upper deflexed.

PALESTINE. J: Deir es Sheikh, 515.

Q. calliprinos Webb var. **brachybalanos** (Ky.) Alph. DC. in DC. Prodr. 16, 2: 55. 1864 (Figure 15c)

A. Camus, Monogr. 1: 458. 1936–38.

Q. brachybalanos Ky. ex Alph. DC. in DC. Prodr. 16, 2: 55. 1864.

PALESTINE. CA: Haifa, maquis, *A. Shibel* 142 g. SA: Jenin, 141 a.

Q. calliprinos Webb var. **puberula** Zoh. var. nov.

Folia late ovata, multo crassiora quam in ceteris varietatibus, subtus pubis brevibus furcatis vel stellatis obsita.

Leaves broad-ovate, much thicker than in other varieties, lower surface covered with short furcate or stellate hairs.

PALESTINE. E: Betw. Tafile and Shaubak, about 1500 m, *ZM* et *F* 727; Bit Dabaghat, betw. Wadi Musa and Shaubak, 1600–1676 m, *D* 9341.

Q. calliprinos is an East Mediterranean species and a leading maquis shrub or small tree which never occurs outside Mediterranean conditions. Single or groups of specimens may, however, occur at a considerable distance from the Eu-Mediterranean belt. Thus the occurrence of single individuals of this species is not always indicative of the phytogeographic nature of the area concerned. As a rule, typical *Q. calliprinos* maquis is limited altitudinally to between 300 and 1000 m. In this zone *Q. calliprinos* is the dominant of the *Q. calliprinos — Pistacia palaestina* association, which is one of the most characteristic plant communities of the East Mediterranean maquis and which has been described in detail for Palestine by the author (Zohary 1960). In Mediterranean Lebanon, Syria and Turkey this community — although somewhat deviating in composition from the Palestinian one — can still be considered the same major unit. For Turkey this maquis has been described by Schwarz (1936a). In Syria, in the environs of Jebel Eriha, northern Syria, 950 m above sea level, we still found the typical form of *Quercetum calliprini* comprising among others: *Q. calliprinos, Pistacia palaestina, Crataegus azarolus, Rhamnus palaestina, Styrax officinalis, Prunus ursina, Amygdalus orientalis, Rubia olivieri, Smilax aspera, Asparagus aphyllus, Clematis cirrhosa.*

Maquis of *Quercus calliprinos* when destroyed may on certain soils be invaded by pine forests. Under the canopy of these *Pineta*, the maquis slowly regenerates and becomes so dense that the light demanding pine seedlings die away under its heavy shade. With the comparatively short-lived pines no longer regenerating, the *Pinetum* finally disappears and the original maquis regains its terrain.

The most interesting forest or maquis type of *Q. calliprinos* is that of Edom (southern Transjordan) where this species is represented by a particular variety (var. *puberula*) and where some steppe components occur as underwood. This maquis occupies here altitudes of between 1500–1670 m. They present the southernmost outpost of the Mediterranean maquis in general. Another interesting variant of semisteppe maquis is that occurring in Djebel Druze where *Q. calliprinos* is accompanied by *Crataegus azarolus* and *C. sinaica, Pyrus syriaca, Amygdalus communis* and many semisteppe chamaephytes.

Fruit forms of *Quercus ithaburensis* Dcne. (Figures 1–9) and of *Q. calliprinos* Webb (Figures 10–15). Figures 1–5. *Q. ithaburensis* var. *ithaburensis*; Figure 6. *Q. ithaburensis* var. *sucalva*; Figure 7. *Q. ithaburensis* var. *dolicholepis*; Figure 8. *Q. ithaburensis* var. *subinclusa*; Figure 9. *Q. ithaburensis* var. *calliprinoides*; Figure 10. *Q. calliprinos* var. *fenzlii;* Figure 11. *Q. calliprinos* var. *eucalliprinos;* Figure 12. *Q. calliprinos* var. *palaestina;* Figure 13. *Q. calliprincs* var. *eigii;* Figure 14. *Q. calliprinos* var. *subglcbosa;* Figure 15. *Q. calliprinos* var. *brachybalanos*.

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NOTE

The inhibition of IAA oxidase by phenolic substances present in lettuce seeds

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The presence of a thermostable inhibitor of IAA oxidase in homogenates prepared from lettuce seeds and seedlings has been shown (Blumenthal-Goldschmidt 1960). Some attempts were made to identify this inhibitor, and the results are reported in this paper.

Extracts of lettuce seeds, containing the inhibitor were prepared in two different ways:

1. Ground seeds were extracted with boiling water for 10 minutes, squeezed through cheesecloth and the solution centrifuged at 20000 × g for 20 minutes. The supernatant, free of mitochondria, was used as a source of the inhibitor.

2. Whole seeds were extracted in boiling methanol for 10 minutes, the extract decanted and the seeds were washed twice with methanol. All the extracts were pooled together and evaporated under reduced pressure. The residue was used for separation by means of paper chromatography or it was dissolved in water and used as a source of the inhibitor.

In both cases about 10 ml solvent were used per gram of seeds or seedlings. Water extracts were more effective than methanolic extracts in inhibiting IAA oxidase activity. However by prolonging extraction in methanol by 24 hours at 4°C, extracts as active as aqueous ones were obtained.

The methanolic extracts were separated by ascending paper chromatography using Whatman No. 1 filter and paper butanol — acetic acid — water (6:1:2) as the solvent. Chromatograms were dried and examined in U.V. light immediately after drying and again after exposure to ammonia. Part of the chromatograms were used for spot tests with different reagents; the others were cut into 11 zones. Each zone was eluted three times with methanol for two hours at room temperature.

IAA oxidase was prepared from 8 day-old etiolated Alaska peas by the procedure described by Rabin and Klein (1958). Each ml of the reaction mixture contained 0.1 ml enzyme preparation, $MnCl_2 10^{-4}M$, 2,4–dichlorophenol — $4 \times 10^{-4}M$, 22μg IAA, different amounts of inhibitory substances, as well as McIlvain phosphate-

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citrate buffer pH-5.5 to the required volume. The mixture was incubated at 26°C and IAA estimated at intervals using the method of Tang and Bonner.

The lettuce seed extracts were found to contain more than one inhibitory substance, and most of these substances were phenolic in nature. Eight fluorescent zones appeared on the chromatograms at Rfs of 0.07, 0.13, 0.16, 0.21, 0.23, 0.45, 0.56, and 0.81. IAA oxidase activity was inhibited most markedly by eluates from the zone at Rf. 0.81, but the whole area between Rfs 0.21 – 0.45 was also inhibitory. Markers of caffeic and chlorogenic acids ran at Rfs of 0.80 and 0.54 respectively. All these spots as well as the markers gave positive reactions for phenols. Water and methanolic extracts inhibited the IAA oxidation completely only when added at concentrations equivalent to 3.3 mg of seeds per one ml of reaction mixture. When smaller amounts of the extracts were used, the lag period before the onset of oxidation was prolonged and the rate of oxidation of IAA was lowered (see Table I). The same phenomenon was observed when low concentrations of chlorogenic acid were added to the reaction mixture (Table I). The length of the lag period and rate of oxidation in the absence of any inhibitor were proportional to enzyme concentration (Table I).

TABLE I

Effect of amount of enzyme and addition of inhibitors on the rate of oxidation and lag period of oxidation of IAA by pea root enzyme

Additions to reaction mixture	Lag period in minutes	Rate μg IAA oxidised/min
0.5 ml enzyme	7.5	1.03
0.75 " "	5.0	1.80
1.00 " "	2.5	2.22
Lettuce homogenate (prepared from one g fresh weight /10ml)		
0.0 ml (control)	25	1.10
0.005 "	26	1.08
0.05 "	28	0.44
0.5 "	60*	0
Chlorogenic acid		
0 (control)	5.2	0.76
1 μg	8.0	0.68
2 μg	10.0	0.62
4 μg	20.2	0.55

* End of the experiment.

Rabin and Klein (1958) showed that chlorogenic and caffeic acids inhibit IAA oxidase activity and Butler (1960) showed the presence of large amounts of chlorogenic acids in lettuce seeds. The findings reported here confirm these results and suggest that the inhibitor of IAA oxidase present in lettuce seeds consists of chlorogenic acid and probably caffeic acid together with other phenolic compounds. Although Butler could not show the presence of caffeic acid in either lettuce seeds or seedlings, the presence of a spot at Rf 0.81 having a strong bright blue fluorescence, is suggestive of caffeic acid. This spot appeared more strongly in chromatograms of seedling extracts than in those of seeds. It is probable therefore that caffeic acid arises from chlorogenic acid during germination. This possibility is being investigated further.

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PROCEEDINGS OF THE BOTANICAL SOCIETY OF ISRAEL

At the Fourth Congress of Scientific Societies of the Association for the Advancement of Science in Israel
Held in Rehovoth on 2–5 April, 1961

First Session, Tuesday morning 4.4.61 Chairman: J. GALIL

Toxic effects of *Adenostoma fasciculatum* (Chamise) in the Californian chaparral*

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Climax communities of the Californian chaparral in Mediterranean climatic conditions, dominated by Chamise, are distinguished by the complete absence of a grass understorey beneath these shrubs and on their edges. Sometimes even a bare strip is formed with adjacent grasslands.

A combined field study and germination and growth test with *Bromus mollis* — an abundant annual grass in the above mentioned grasslands — revealed the presence of a toxic compound in the leaves and the roots of this brush, inhibiting germination and growth — and in a much lower concentration, acting as growth stimulator. This toxic compound is water and alcohol soluble and heat non-stable. Its molecular structure and biological nature are still under study.

The possibility, that the toxic influence is not restricted only to the grass understorey, but also affects the microflora and the ecosystem as a whole, is discussed. These assumptions may lead to a new approach to the ecological evaluation of fire and the validity of the "climax" concept.

Heterostyly and self-incompatibility in *Narcissus tazetta* L. (Series Bicolores)

RIVKA DULBERGER, *Department of Botany, The University of Tel-Aviv*

Outlines of the vegetation of Iran

M. ZOHARY, *Department of Botany, The Hebrew University of Jerusalem*

Indicator reactions of cotton to changes in soil moisture

M. OFIR, *Department of Irrigation and Soil Technology, Agricultural Research Station, Rehovoth*

When plant roots can not supply water fast enough to balance transpiration losses, dehydration of cells increases and turgor decreases, which, in turn, adversely affect the assimilatory activity of the plant, as well as rate of growth and yields.

* This study was carried out under the World Wide Program of Visiting Research Scientists of the National Academy of Sciences, U.S.A., in cooperation with A.M. Schultz, R.Q. Landers and H.H. Biswell from the School of Forestry, Univ. of California, Berkeley and R. S. Stanley from the Pacific Forest and Range Exper. Sta., Berkeley.

Changes in hydration are reflected in measurable changes in the concentration of cell sap. Variations in stomatal aperture can be measured to obtain an indication of changes in turgor. Under any given set of climatic conditions, relevant data can usefully serve as indicators of the reaction of plants to changes in soil moisture conditions.

In the course of irrigation experiments with cotton in the Esdraelon Valley and the Beit-Shean Valley in 1960, changes in stomatal apertures were measured by infiltration as well as directly, by microscopic observation. Simultaneously, the concentration of cell sap was measured cryoscopically and refractometrically. Rates of growth of young internodes and variations in soil moisture were recorded. Yields obtained with different irrigation schedules were measured.

Within a certain range of soil moisture, stomatal apertures decreased and cell sap concentration increased in response to decreasing moisture. Plants which endure this range of moisture for many days showed a pronounced reduction in yields. All considered, this range of soil moisture should be considered as critical for the physiological activity of the cotton plant as reflected in its yield.

Second Session, Tuesday afternoon 4.4.61 Chairman: DANIEL ZOHARY

Mutual antagonism between gibberellin and Amo-1618 in growth, respiration and catalase activity of cucumber seedlings

A. H. HALEVY, *Faculty of Agriculture, The Hebrew University, Rehovoth*

Quaternary ammonium compounds are a group of growth retarding chemicals. Unlike other types of growth inhibitors, they retard stem elongation, intensify the green colour of leaves and delay flowering without causing malformation of the plant. The most active of these compounds was found to be (4-hydroxy-5-isopropyl-2-methylphenyl) trimethylammonium chloride, 1-piperidine carboxylate, which was designated as Amo-1618.

Cucumber seedlings were grown in Petri dishes on filter paper wetted with aqueous solutions containing various concentrations of gibberellin (GA), Amo-1618, and mixtures of these two chemicals. Their interaction and effect on growth, respiration and catalase activity of various parts of the seedlings was investigated.

Gibberellin doubled hypocotyl length in light-grown seedlings, but only slightly stimulated its elongation in the dark. The effect of GA on roots varied according to the concentration and light conditions. Generally GA slightly stimulated root elongation at lower concentrations and had little retarding effect at higher concentrations. Amo-1618 retarded considerably root and hypocotyl elongation both in light and in darkness. GA did not reduce the inhibitory effect of Amo-1618 on root growth, but counteracted the retardation of the hypocotyl in darkness as well as in light. This indicates that gibberellin may be active in darkness not less than in light when a factor which retards growth is present.

GA caused an increase in respiration of the cotyledons and hypocotyl and decreased root respiration. The contrary was found with Amo-1618: it caused a reduction in hypocotyl and cotyledon respiration and increased root respiration. Application of GA and Amo-1618 in concentrations which antagonised the effect on hypocotyl length counteracted the effect on respiration of cotyledons, hypocotyl and root. The effect on roots is noteworthy since GA did not antagonize the retardation effect of Amo-1618 on root elongation. Gibberellin caused an increase in catalase activity of the cotyledons but had no significant effect on catalase activities of roots and hypocotyl. Amo-1618 decreased catalase activity in all three organs. The inhibitory effect of Amo-1618 on catalase activity was not counteracted by GA.

Effects of indoleacetic acid and kinetin on radiation damage

RUTH GUTTMAN, *Department of Experimental Medicine and Cancer Research, The Hebrew University-Hadassah Medical School, Jerusalem*

Irradiation of growing tissues is generally followed by a delay in nuclear and cell division and by the appearance of chromosomal abnormalities. In the studies reported here, the effects of post-irradiation treatment with indoleacetic acid (IAA) and 6-furfuryl amino purine (kinetin) were examined in root tips of *Allium cepa*, irradiated with 70 r at different stages of the cell division cycle.

Kinetin, alone, did not influence the rate of recovery from mitotic delay caused by the x-rays. IAA, alone, affected cell division rates only in cells irradiated at or just prior to prophase. IAA and kinetin, applied together, produced complete recovery regardless of the time of irradiation.

Rejoining of x-ray induced chromosome-breaks was stimulated by kinetin in cells irradiated close to mitosis but not during interphase. IAA had no influence on break-rejoining at any time. IAA and kinetin together, were again most effective; they significantly lowered the proportions of aberrant anaphases, regardless of whether irradiation had taken place during interphase or pre-mitosis.

It is proposed that both IAA and kinetin-like substances are necessary for the initiation of mitosis but that the radiation sensitivity of each substance reaches a maximum at different stages in the cell division cycle.

Studies on plant antitranspirants*

J. GALE, *Department of Botany, The Hebrew University of Jerusalem*

The main loss of water from fields covered by crops is by leaf transpiration. Reduction of transpiration should cause a concomitant saving of irrigation water. Recent studies have shown that 90% of transpiration is of no service to the plant and, under arid and semi-arid conditions, may be harmful.

In the past horticulturalists have applied antitranspirants — usually in the form of wax emulsions — as an aid to transplantation. Little research on the physiological effects of such materials has been carried out and the results are conflicting.

* This project is receiving the support of the Ford Foundation.

We have tried to find an antitranspirant which ideally could be applied as a spray, would be non-phytotoxic and would be selectively permeable to gases, being impervious to water vapour but permeable to CO_2 and O_2. Laboratory and field experiments have shown that certain polyvinyl compounds are promising in this respect.

The transpiration reduction of *Phaseolus* by such compounds was very variable when measured over an extended period. Results of later experiments from transpiration and stomatal aperture curves drawn, were able to explain this variability. In Jerusalem, in summer, stomata of *Phaseolus* close very early in the day, owing apparently to atmospheric drought. This closure reduces transpiration by about 70%. The antitranspirant reduced transpiration by about 30% and this delayed or prevented the hydroactive stomatal closure, resulting in a total diurnal transpiration which was sometimes greater in the treated than in the untreated plants. This is further complicated by interactions between soil moisture, climatic and plant factors.

However, the treated plants showed increased growth which may be ascribed to improved hydrature of the plasma and augmented photosynthesis. Preliminary field experiments with an improved antitranspirant indicated greater resistance to drought conditions and increased dry matter production, without an increased total transpiration, and this under various soil moisture regimes.

The growth of plants under very low light intensities*

AVISHAG KADMAN-ZAHAVI, *The National and University Institute for Agriculture, Rehovoth*

When trying to analyze the primary effects of light on flowering and on other morphogenetic phenomena it is necessary to work with short exposures to low intensity light. This for two reasons: I. In order to avoid possible complications by photosynthesis. II. Low intensities and short exposures are needed in order to avoid saturation of the pigments. It has been shown that the relative effectiveness of different light sources may change with the change of light intensity and with the change of the duration of the illuminations[1]. As the correct control to which a certain light treatment may be compared is to a "no-light" treatment, the controls are kept in complete darkness.

In the present work the "periodic" element of the "photoperiodic" treatment is provided by applying short light exposures over different parts of a 24 hour period. Two rooms receive the same amount of light (72 minutes of red light). The first one is illuminated for 3 minutes every hour for 24 hours (*long day*). The second room is illuminated for 6 minutes every ½ hour for 6 hours daily (*short day*). A third room is illuminated once daily for 12 minutes.

* This investigation was aided by a grant from the Israel Foundations Trustees.

Temperature is kept at about 23°C. At present only red light (4 40W "pink" fluorescent tubes, wrapped in orange cellophane) is used.

Large seeded plants (peas, *Xanthium*, *Pharbitis*, etc.) are grown in vermiculite with or without sugar sprays. Small-seeded plants are grown on sugar in test tubes (*Chenopodium*, *Arabidopsis*, *Hyoscyamus*, *Spinacia*, etc.).

Preliminary results on growth and flowering of the different plants under the above-mentioned conditions will be reported.

Thanks are due to Prof. A. Lang, Prof. F. Lona, Dr. B. G. Cumming, Dr. P.J.A.L. de Lint, Dr. W. Haupt and Dr. S. Nakayama for the supply of the seeds.

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PROCEEDINGS OF THE GENETICS SOCIETY OF ISRAEL

At the Fourth Congress of Scientific Societies of the Association for the Advancement of Science in Israel
Held in Rehovoth on 2–5 April, 1961

First Session, Tuesday morning 4.4.61 Chairman: E. GOLDSCHMIDT

Genetics and Breeding

Spininess in *Ricinus* as a morphogenetic model

HAVA STEIN, *The Weizmann Institute of Science, Rehovoth*

At the S (spiny capsule) locus, there are 4 alleles : S — spiny capsule, s^r — majority of capsules spineless, s, s^f — completely spineless, similar to each other when homozygous, hence considered isoalleles. S is partially dominant: Ss^r, Ss, Ss^f are spiny, but number of spines is much lower than in SS. Number of spines also decreases from Ss^r to Ss^f: $SS > Ss^r > Ss > Ss^f$. In Ss^f plants, a strikingly regular variation in spine number was observed. Within each plant, spine number increases from the first raceme to later ones. Within each raceme, spine number increases from first capsule to later ones. Apparently, increase in spine number is correlated with a shift (to the right) in the vegetative/reproductive balance. Hence, increase in spine number might be correlated with growth inhibition in general. This assumption was tested by gibberellin treatments, pruning, and continuous removal of most leaves. The gibberellin treatment and the pruning resulted in growth stimulation and decrease in spine number, as expected, but the decrease was not significant. Continuous removal of most leaves caused striking growth inhibition and a highly significant increase in spine number. The correlation between growth rate and spine number supports the assumption that spine formation is determined by a mobile substance produced in vegetative plant parts, which may be identical with one of the growth substances. This assumption may also be tested by local application of growth substances. Spine development serves as a convenient morphogenetic model, because the structure of the developing organ is very simple, the genetic determination is well understood, and physiological induction lends itself to experimental manipulation.

Inheritance of yield components in a diallel cross of cotton

A. MARANI, *Department of Field and Vegetable Crops, The National and University Institute of Agriculture, Rehovoth*

Three varieties of *Gossypium hirsutum* (Acala 4/42, Coker 100A, Empire) and three varieties of *Gossypium barbadense* (Pima 32, Pima S-1, Ashmuni) were crossed in all combinations. The 15 F_1's and the parents were compared in a "Youden-square" with 5 replicates.

A very strong heterotic effect, more pronounced in crosses between varieties belonging to different species, was observed for the following characters: Date of first flower, height of plants, yield of seed-cotton, yield of lint, and seed-index. On the other hand, characters like mean maturity date, boll-weight, and lint index showed heterosis in crosses between varieties belonging to the same species. In crosses between varieties belonging to different species the F_1's were intermediate for these characters.

Lint out-turn was higher than the mean of the parents in F_1's between varieties of the same species. In F_1's of crosses between varieties belonging to different species, it was lower than that of the lowest parent. The data were analyzed by the method proposed by Hayman[1] and Jinks[2]. A distinctive overdominance was found in yield of seed-cotton and height of plants, a simple complete dominance in lodging-resistance, and partial dominance in boll-weight and mean maturity date.

The *Gossypium hirsutum* varieties included in this trial showed dominance in date of first flower and yield of seed-cotton. The *Gossypium barbadense* varieties showed dominance in height of plant, lodging-resistance, and lint out-turn.

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Hybridization between two species separated by physiological and morphological blocks. Some experiments in the genus *Phaseolus*

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Two morphologically different seedling growth blocks were observed in interspecific hybrids between various *P. vulgaris* varieties and a strain of *P. coccineus*, variety Scarlet Runner.

Three *P. vulgaris* varieties produced a (interspecific) dwarf hybrid, designated as T dwarf after the variety Tendergreen in whose crosses it was first observed. The leaves and stems were greatly reduced in size, rugose and stippled with small red-brown spots. The flowers appeared normal and viable pollen was produced. No seed set was obtained on this type of dwarf.

The *P. vulgaris* variety Blue Lake produced a dwarf hybrid designated as B dwarf. The B dwarf seedlings were greatly reduced in size and died within 4–5 weeks after germination. The leaves were not rugose or stippled as in the case of T dwarfs. Reciprocal crosses between the *P. vulgaris* varieties were all normal.

Results of test crosses in various directions indicated that different ways of bridging the barrier between the two species exist. The loci responsible for T and for B dwarfs are inherited independently. A series of three alleles at each locus was proposed. These were designated by the exponents v, vc, and c for each loci. At the B locus B^v

s incompatible with B^c, producing B dwarfs. B^{vc} is compatible with both B^v or B^c. The same hypothesis is proposed for the T locus. The cross compatible genotype between *P. vulgaris* and *P. coccineus* would be $T^{vc}T^{vc}B^{vc}B^{vc}$.

The general implications of the results are discussed.

Progeny tests for differences in growth ability in carp

R. MOAV, G. WOHLFARTH AND M. LAHMAN, *Department of Botany, The Hebrew University, of Jerusalem, and Fish Culture Research Station, Dor*

The progeny of several pairs of carp were tested at Dor, during three seasons. In the summer of 1959, the progeny of four pairs of mirror carp were each stocked into four fattening ponds. In addition to the mirror carp, all the 16 ponds were stocked with equal number of scaly carp of a single spawn. The growth rate of the mirror progenies relative to the scaly fish was found to be very different for the four mirror groups. Unexpectedly, the scaly fish which were stocked with the "slow" mirror progenies had a significantly higher growth rate than their sibs which were stocked with the "fast" mirror progenies. Through this compensation, the yield differences between the ponds were not significant.

In the fall of 1959, and spring of 1960, each one of 16 fattening ponds was stocked with equal proportions of offspring of five progeny groups. In the summer of 1960, seven pairs were mated each one at a different settlement, and their progeny was tested simultaneously in mixed ponds at all the seven settlements.

The last three experiments have shown again marked differences between the progenies. It was also found that the initial weight of the fingerling when planted in the fattening ponds is an important factor in determining the relative growth rate throughout the growing season. The environmental conditions at the different settlements were widely different, nevertheless the ranking of the seven progenies was identical in the various settlements.

All the reported tests were performed in mixed ponds, where at least two progeny groups were stocked together. Due to the possibility of strong interactions among the various progenies, it is impossible yet, to translate the results of the mixed ponds, into differences in yields in single-progeny ponds.

Second Session, Tuesday afternoon 4.4.61 Chairman: Y. WAHRMAN

Evolution and Cytology

The origin of tobacco; new problems

D. U. GERSTEL, *North Carolina State College, Raleigh, N.C., U.S.A.**

The origin of each one of our many polyploid crop plants presents some problems of its own. The ancestry of tobacco is one of the less perplexing ones and this cultigen was the first one to be synthesized from its putative ancestors. By 1940 only minor

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details appeared to be lacking; e.g., it has not yet been conclusively determined which contemporary species of the *Tomentosa* group is most like the one which went into the original hybrid. Or, since the *Tomentosae* are short-day bloomers and *N. sylvestris*, the other suspected parent, requires a long day, the extent of overlap of flowering time in the field needs to be considered. Recent biochemical studies performed in a number of laboratories have brought out new problems. Tobacco is used by man because it contains a stimulant — nicotine. This alkaloid is largely produced in the roots, translocated to the leaves and retained there through the ripening and curing processes. The wild species mentioned also produce nicotine, but when the leaves mature and turn yellow, nicotine is converted into the useless nor-nicotine.

This enzymatic process is caused by a single dominant gene in each species. It is most likely that the allopolyploid ancestor existed, before it was used by man, as a wild plant, even though tobacco is known now only as a cultigen. This ancestor had necessarily two converter genes, one from each parent, and its mature leaves would not have been fit to chew or smoke. Such a plant would hardly have been attractive to man in the form it is now utilized, i.e., after maturing of the leaves. More probably, it was used originally before the converter enzyme could act, i.e., in the green state; or green leaves could have been exposed to heat sufficient to destroy the enzyme or to dehydrate the leaves to prevent enzyme activity. Unfortunately, only scant anthropological evidence is available on the early methods of harvest and post-harvest treatment. A further problem is how loss of two independent converter genes could have been recognized and lines with first only one and then without converter selected for agronomic use.

Experiments in establishment of orchard grass (*Dactylis glomerata*) in the Negev

Daniel ZOHARY, *Department of Botany, The Hebrew University of Jerusalem*

Variability in *Carthamus spp.* in the Galilee

A. ASHRI, *Department of Field and Vegetable Crops, The National and University Institute of Agriculture, Rehovoth*

The distribution areas of *C. glaucus* M.B. and *C. tenuis* (Boiss.) Bornm. overlap in the Lower Galilee between Lavie and Rama. There is evidence of hybridization between the two and, subsequent introgression leading to the high degree of variability found there. It is suggested that the *Carthamus* form which grows in the Upper Galilee arose from such hybridization.

A trisomic plant in *Ricinus communis* L.

K.M. JAKOB, *Plant Genetics Section, The Weizmann Institute of Science, Rehovoth*

A castor oil plant trisomic for a single chromosome (probably C) was derived by open pollination from a morphologically normal but highly sterile complex trisomic. This trisomic had originated from a cross between a colchicine induced autotetraploid

and a normal diploid of the variety Adamdam. The inflorescences of the simple trisomic lack female flowers, having only male flowers and an occasional single hermaphrodite flower near the tip of the raceme. Capsules of the hermaphrodites always fall off before maturation of the capsule. Though having fewer anthers and less pollen per anther than normal male flowers, the trisomic is at least partially male fertile. Its meiosis will be described with emphasis on a comparison between trisomic and normal plants in respect to the pachytene pairing of the chromosome complements.

Sterility in a cross between distant ecotypes in *Ricinus*

HAVA STEIN, *The Weizmann Institute of Science, Rehovoth*

All *Ricinus* types belong to one species, *R. communis*, since all are intercompatible. The abundant striking morphological differences are mostly single gene characters and cannot serve as taxonomic criteria. Therefore, the following case of sterility in a cross between distant ecotypes is of some taxonomic – evolutionary interest. In one parent, "Early Spineless", which probably originated in China, all developmental processes are accelerated. In the other parent, "Green Sudanese", from Africa, all processes are greatly slowed down. The F_1 plants of both reciprocal crosses are fertile, the F_2 plants from F_1 "Early Spineless" ♀ × "Green Sudanese" ♂ are all fertile, too. In the F_2 obtained from F_1 ♀ "Green Sudanese" × "Early Spineless" ♂, 1/4 of the plants — 19 out of 91 — were (pollen and ovule) sterile. Abortion accurs at a rather advanced stage in pollen development. "Early Spineless" is assumed to carry a recessive gene, *a*, which in the presence of "Green Sudanese" cytoplasm causes sterility. This was tested by pollinating 12 normal sibs of sterile F_2 plants with "Early Spineless" pollen. Of the resulting populations, 1/3 should contain fertile plants only, and 2/3 should segregate into fertiles and steriles in a 1:1 ratio. In fall planting in the greenhouse, all populations had fertile plants only. This, however, may be due to environmental conditions, and the populations will be tested again in spring planting. If the assumption is confirmed, it may indicate a beginning separation of the species.

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